

PUBLIC WORKS

City, County and State



Hubert Street, Memphis, Tennessee. Tarvia-built in 1914, the year the World War began in Europe. The lower photo shows the condition of Hubert Street today.



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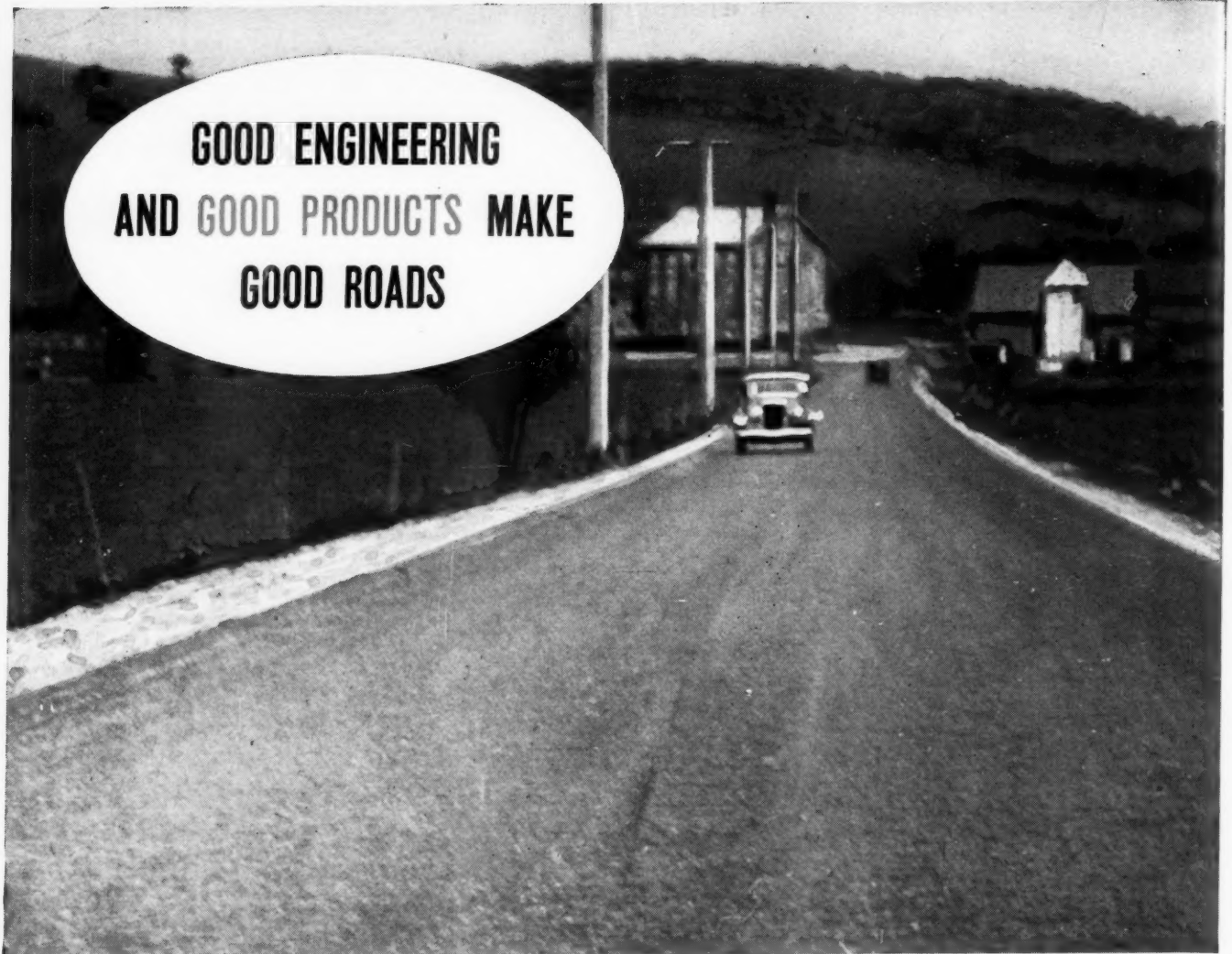
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VOL. 65

PUBLIC WORKS

No. 12

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CITY, COUNTY AND STATE ENGINEERING AND CONSTRUCTION

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Buy Christmas Seals



Help Fight Tuberculosis TIMEWASTERS

These here, you know, printers never have learned to set a square root sign, so our problem at the foot of the column in the November issue wasn't very intelligible. Ye editor being in the fairly sunny south wasn't present to read proof. Well, here is the problem which Brer Eisner warned us against last month:

$$ghi = \sqrt{abcdef}$$

With each of the letters given representing a different digit, from 1 to 9, inclusive.

Mikey and Ikey:

Mikey and Ikey were counting their money and straightening up their tangled finances. Each was lucky enough to have a number of dollar bills. Ikey had half as many as Mikey would have had, had Mikey had half again as many as he actually did have, together with half as many as Ikey had. Ikey gave Mikey one one-dollar bill, whereupon Mikey had half as many as Ikey would have had, had Ikey had half again as many as he had, together with as many as Ikey had. How many did each have to start with? *Bob Clark.*

"An Old Classic":

Given the three altitudes, construct the triangle. *Benjamin Eisner.*

Solutions:

No answers this month for publication. We've had some to the problem contributed by Mr. Quinn; no one has told us the abc. . . problem answer; and apparently everyone's mind is so taken up with thinking about that gin store that they haven't worked out the dope as yet. It's a good problem, though. Go to it.

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A. PRESCOTT FOLWELL, Editor

W. A. HARDENBERGH, Asso. Editor

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PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 65

December, 1934

No. 12

Chemical Treatment of Sewage

A general, non-technical description of what it is, how it operates and what it effects.

STRICTLY speaking, there is more or less chemical action in all kinds and phases of sewage treatment. Treatment may be divided, according to the more prominent features, into mechanical, physical, biological and chemical; but in the great majority of processes all of the last three operate in various degrees. Screening and sedimentation are themselves purely mechanical or physical; but their effectiveness in removing organic matters is affected, in some cases quite materially, by previous chemical and biological action in the sewer or the plant which causes comminution, solution, chemical combinations, and other changes in the quantity or condition of the suspended matter.

Biological action in septic tanks, digestion tanks and

loids, bringing soluble matters into suspension, conditioning sludge to facilitate dewatering it, separation of fats, facilitating bacterial action, disinfection of sewage and effluents, odor control; while inert materials such as clay or paper pulp serve as a nucleus for floc particles or give a "body" to the sludge.

Precipitation

Sewage, in passing through a tank slowly, loses part of the suspended solids by sedimentation. The unsettled solids will pass out with the effluent, giving it a cloudy look, and it is impracticable to keep it in the tank long enough for all of the "settleable" solids to settle out.



By chemical conditioning of activated sludge at Tenafly, N. J., it becomes dry enough to shovel, as shown in the photograph, in 20 to 30 hours after drawing onto glass-covered drying bed in July. (Photograph by courtesy of E. B. Mallory, who will describe the procedure in an early article.)

percolating filters, is accompanied by chemical action which completes the process which biological action begins; and chemicals are frequently used to facilitate the biological action. There can not, we believe, be any biological action in sewage or sludge which is not accompanied or immediately followed by chemical action.

By "chemical treatment," however, we mean the application of substances to sewage or sludge with a view to effecting, assisting or retarding changes in its physical, chemical or bacterial content through chemical action; the result being either in itself an end product, or a step in a more or less complex process.

Chemicals are added to sewage or sewage sludge for a number of purposes, the most common of which are precipitation of suspended matter, flocculation of col-

Precipitation is the addition to sewage of substances which will facilitate or hasten sedimentation of matters in suspension, either the settleable alone or both those and the unsettled. This was the first use made of chemicals in actual practice and scores of materials have been used for this purpose, lime having been accepted for several decades past as offering the most practicable combination of effectiveness and economy. If the sewage is acid, part of the lime is used in rendering it neutral or alkaline. Of that not so used, a considerable part combines with carbonic acid in the sewage to form insoluble calcium carbonate, which collects into flocs, which enmesh with them the fine suspended matters and carry them to the bottom more rapidly than they would settle of themselves.

Other materials are used as coagulating precipitants, such as ferric chloride, ferric sulphate, ferrous sulphate, alum, sodium aluminate, copper sulphate, etc. There is still much to be learned concerning just what takes place when these are added to sewages of different composition—various degrees of acidity or alkalinity, septicity, iron content, etc.—such as the reactions involved, effect of interfering substances, and of dispersion, flocculation, and coagulation of the colloidal and soluble materials. But it may be stated in general terms that the salts are decomposed and recombine with materials in the sewage to form insoluble hydroxides and soluble compounds; the former coagulating into comparatively heavy flocs, which act as does the calcium carbonate from lime referred to above.

Experience, aided and interpreted by theory, has taught that the effectiveness of any given substance as a coagulant is affected by the substances in the sewage with which the chemical reacts; that a chemical satisfactory with one sewage may be comparatively useless in another; and that optimum results often require more or less insignificant modification of treatment. As an illustration of the last, the addition of a little lime to an acid sewage to render it neutral or slightly alkaline before adding one of the other coagulants may greatly improve the results at reduced cost. Or, with the use of ferrous sulphate (which must be oxidized to the ferric form to become insoluble and form flocs), aeration or the application of some oxidizing agent (chlorine, for example) is very desirable.

In most cases, and especially where the doses of chemical are relatively small, thorough mixing to bring about a contact between the chemical and every part of the sewage is very important.

Colloid Flocculation

Probably 10 to 15% of the undissolved solids in sewage are in the colloidal form, and are responsible for about 20 to 25% of the B.O.D. The colloids are so intimately combined with the surrounding water that it is difficult to separate the two, and their presence in sludge is responsible for a large part of the difficulty of dewatering it. Also, colloids as such will not separate from the sewage and settle out in sedimentation. There are three practicable methods of removing colloids—bacterial oxidation (as in percolating filters); causing them to collect into flocs (chiefly by addition of chemicals); and filtration, usually preceded by one or both of the other two.

Flocculation of the colloids in either sewage or sewage sludge is effected by the use of one or more of a number of chemicals. Just how and why these chemicals compel the colloids to act as they do is a matter still in dispute. What is probably the latest theory to find acceptance considers that all colloids carry an excess of positive or negative charge (similar in behavior to static electrical charges), and that those with similar charges repel each other while those with opposite charges tend to floc together. Except when the sewage has a pH of 4.0 or below, most unflocculated protein colloids are negative, and if positive colloids be added to the sewage, or part of the negative ones be made positive (as by charging the pH value), they will combine with these negative ones and form flocs. Such positive colloids are formed by the introduction of ferric chloride, alum and other chemicals, or pulverized carbon.

When small flocs have been formed, they may be com-

bined into larger ones by mild agitation (as by air or "flocculator" paddles), bringing them into contact; but violent agitation may cause them to separate again. Large flocs settle by ordinary sedimentation; those containing iron colloids more rapidly than lighter ones.

The chief feature of "conditioning" of sludge is colloid flocculation to secure weakening of the bond between colloids and water, so that the water may be separated from the sludge, as by draining and evaporation on sand beds, dewatering on vacuum filters, centrifuging, etc.

Other Chemical Actions

Sewage may contain large amounts of iron or other minerals in solution which may interfere with the treatment processes or be objectionable in the effluent; and these can generally be rendered insoluble by the addition of the proper chemicals, and removed as suspended matter. The iron can even be caused to take the form of a ferric coagulant.

Fats intimately combined with sewage, which are removed with difficulty by biological processes, may be separated from it by the addition of sulphuric or other acid.

Many of the soluble constituents of trade wastes can be removed most readily, if not solely, by the addition of chemicals. Also, chemical treatment greatly facilitates biological treatment in the oxidation of certain wastes.

Biological digestion is now almost universally controlled by the use of lime to maintain the pH of the sludge at the optimum point for rapid and inodorous digestion and maximum gasification.

For disinfection of sewage and effluents, and for control of odors (especially hydrogen sulphide) about sewage plants, chlorine is the chemical most commonly used, being effective, comparatively cheap, readily available and applicable, and best understood.

As is indicated above, most forms of chemical treatment are employed to hasten, improve the effectiveness of, or decrease the cost of biological, physical or mechanical treatment methods. Some trade wastes can not be purified readily, if at all, without the use of chemicals; but most results can be obtained without the intentional application of chemicals. Removal of colloids, for example, can be effected by biological oxidation in filters. But in many cases, chemical treatment will permit economies in construction or operation of plant, or both; and it is much more flexible than any of the biological processes, which can adapt themselves but slowly and within limits to changes in quantity or quality of sewage, while chemical treatment can be changed instantly to meet unlimited changes either in volume of sewage, or in quality due to discharges of trade wastes or other intermittent causes.

The above was written as a general introduction to the subject. We expect to publish, during 1935, a series of articles on Chemical Treatment of Sewage, written by recognized authorities on the subject, describing its various uses, such as in supplementing or aiding biological treatment, in precipitation, sludge conditioning, treating commercial waste waters, and others; the characteristics of the various chemicals used, and methods of applying them. Also brief descriptions of the applications of the several forms of chemical treatment, separately or combined, in actual practice and in experimental or test plants.



Chains were pulled to standard tension determined by temperature.

AT THE organization of the Civil Works Administration, a geodetic control survey project for each state was approved, to be under technical direction of the Coast and Geodetic Survey. This Bureau designated an engineer in each state as its State Representative. In Maryland, Professor S. S. Steinberg, head of the Department of Civil Engineering, University of Maryland, was appointed State Representative, and offices were established in the engineering building of the University at College Park.

Rapid employment of men was the primary objective of the CWA; efficiency of operation was secondary, and entirely dependent on the personal equation of the State Representative.

Maryland was allotted 420 men. The first appointment was made December 4, 1933, the first party took the field on December 7, and by January 11 virtually the entire allotment had been reached with 38 parties at work. The judgment of the State Representative that a small reserve was advisable, was fully vindicated during the later stages of the work, when he found it possible to place certain men of unusual qualifications, who were not available during the early stages of the work.

Organization

Equipping and dispatch of these parties were no minor feats of organization. No money was available for major instrumental equipment and a call was broadcast to all engineering organizations in Maryland requesting loans of idle instruments. A generous response was received, 107 transits alone being offered, and at no time was any lack of equipment experienced. In addition to field equipment of every type, computing machines, bookkeeping

machines, typewriters and general office equipment were offered and accepted.

As the work to be done had to meet second order Coast and Geodetic Survey specifications, it was necessary to test all transits and levels and standardize all tapes, which were of every type and description found in daily engineering practice. A regulation tape, previously standardized by the U. S. Bureau of Standards, was sent from the Coast and Geodetic Survey, and permanent marks were set in the floor of the field house of the University athletic department, facilitating rapid standardization of tapes at any time. Transits and levels were adjusted in the field by each instrument man, under immediate supervision of the chief of party, following the standard method of the Coast and Geodetic manual.

Field parties were organized as combined traverse and level parties, and consisted of ten men as follows:

1 Chief of party, 2 instrument men (transit man and level man), 2 recorders, 2 rodmen, 2 chainmen, and 1 axeman.

An order promulgated in November by the Federal Emergency Relief Administration authorizes cooperation with any State public works commission, any State or County highway department, the engineering department of any city or town, or of any State educational institution, in the making of a Supplemental Geodetic Control Survey. A broad blanket approval has been given this project so that it can be instituted immediately by any State, County or City F E R A administrator without further approval by Washington authorities, wherever and whenever a sponsor for this type of work is obtained, and suitable personnel is available on the relief rolls. It is believed that the Coast and Geodetic Survey will cooperate in the same manner as it did last winter on a similar project with the CWA, and that wherever possible the work begun at that time will be continued.

This party organization was selected as best suited to operate in isolation, as a self contained unit fitted to do all work on any given circuit. As was to be expected, leveling progressed more rapidly than traversing, with 500 miles of one to 365 miles of the other during the time this project was active.

Seven field districts were organized, covering the entire state, each under a supervising engineer. He endeavored to inspect the work of each party each day, and had daily contact with the State Representative, either in person or by telephone.

Party location reached every section of the State.

In Maryland alone 415 engineers were employed last winter running 365 miles of 2nd order traverse and 500 miles of precise leveling under coast and Geodetic Survey specifications.

Federal Winter Work for Civil Engineers

By J. W. Swaren M. Am. Soc. C. E.

Distribution of these was influenced by: 1—Population, generally proportional to unemployed engineers. 2—Property values. 3—Probable future growth. This resulted in some concentration of work in a triangle lying between the District of Columbia, Baltimore, and Frederick, but with a dispersion that provided work for unemployed engineers in all counties of the state.

Party personnel was selected from lists on file in the county offices of the National Reemployment Service. Assignment of men without strict regard to county lines was allowed, especially in the higher grades. This facilitated the building of an aggressive, homogeneous organization with a high degree of efficiency and a real morale. This would have been difficult of attainment had the usual regulations of the CWA been enforced.

Each chief of party was given a brief training and special instructions by the State director as it was deemed important to have all routine work handled in a uniform manner. Special emphasis was put on the fact that this work was essentially Coast and Geodetic Survey practice and must be of a character in accord with the traditions of that service. It was impressed on him that temporarily, at least, he was a field representative of the Survey, doing public work, with public funds, and that his records and work must be able to withstand any scrutiny directed toward it. Effect of this training is reflected in marked uniformity of completed work, as well as a high standard of accuracy.

At the central office a general administrative division was organized, under a supervising engineer, with clerical, accounting, computing and drafting sections.

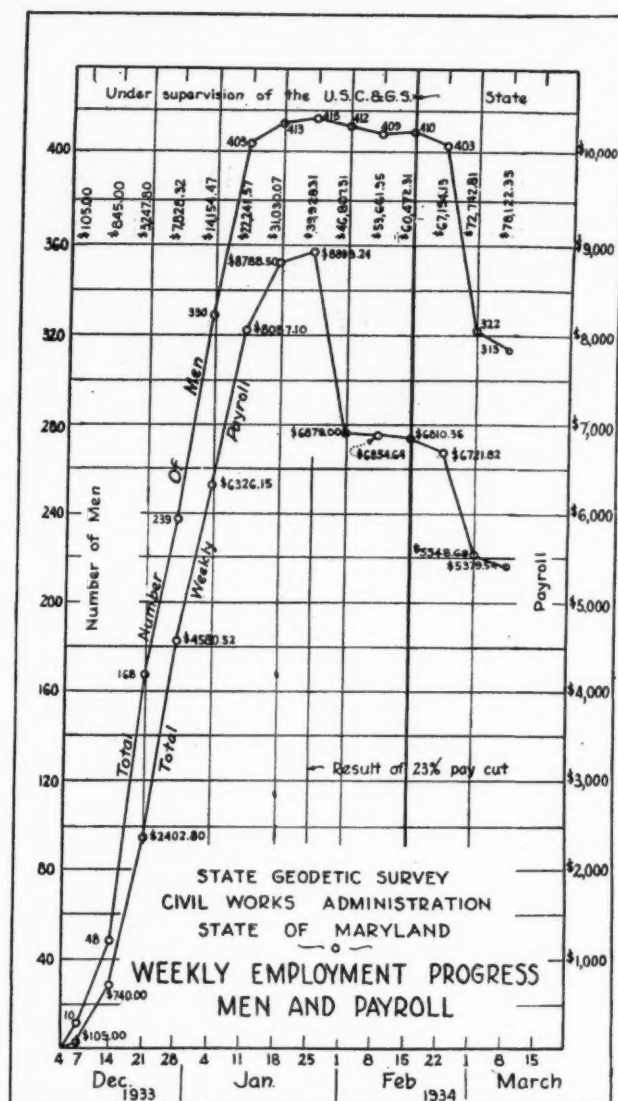
Each field party, through cooperation of local officials, was able to establish suitable field offices without recourse to tentage. These were in public buildings of various types, fire engine houses, police stations, court house—in short, whatever building was available. In most places suitable furniture was provided, although in a few instances the party found it necessary to make tables and benches.

So far as possible, parties were so assigned that the members could return to their homes at night. Field transportation was provided by two automobiles for each party; usually owned and driven by party members, with gas and oil allowances for official use.

The Work Done

Because of the shape of Maryland, the Lambert Conformal Conic Projection was selected for use in the Maryland project. The State, though small in area, has more controls for its survey than many of the larger states. Along the Eastern Shore and both sides of Chesapeake Bay below Annapolis, the first order triangulation net projected by the Coast and Geodetic Survey has provided control, although not always at commercially convenient points. In the vicinity of Baltimore a four quadrant network, based on rectangular coordinates, is used, its zero point being the Washington Monument at Mt. Vernon Place and St. Charles Street, Baltimore. In Western Maryland, surveys have been tied into the Pittsburgh or Allegheny first order triangulation net of the Coast and Geodetic Survey.

Since 1917, in the immediate vicinity of Washington, a new network has been developed by the Washington Suburban Sanitary Commission. This is on rectangular coordinates and is centered on the tip of the Statue of Liberty atop the Capitol. It is tied into a



series of monuments established by the Coast and Geodetic Survey through lower Montgomery and upper Prince Georges county, and is of 2nd order accuracy, with more than 1500 bench marks in an area of less than forty square miles.

It was hoped under the Civil Works project to obtain a network covering the entire state, so that all future surveys, public and private, could be tied into this control at a minimum expense. Actually 575 concrete traverse monuments were set, and 615 level bench marks were referenced. The routes traversed by the field parties followed principal improved highways as far as it was possible to do so. Monuments were set in pairs one quarter mile apart and two miles between pairs. Wherever this line passed an incorporated town or village, a pair of monuments were set so that local surveys can be made with a minimum of time and expense.

East of Frederick the monuments are 8 inches square at the top and 10 inches square at the bottom and three feet long. West of Frederick, because of the deeper frost lines, the monuments are four feet long. A 1:2:3 mix of cement, sand and gravel was used, materials being purchased with Civil Works funds. The Coast

and Geodetic Survey furnished a bronze disk to be set in the top of the monuments, in which eventually will be stamped the marker number and its elevation. Casting was done at division headquarters, and the monuments were transported to the field parties by trucks borrowed for this purpose from the State Roads Commission.

Every caution was exercised in selecting the exact location for each monument as an insurance of maximum permanency. Points possibly subject to erosion, wash-outs, or landslides, or to disturbance by farming or construction operations were avoided. Likewise, roads which it seemed reasonably certain would undergo extensive reconstruction or be a part of the future road program, were not included in any circuit if an alternate route were possible. Actual planting of the monuments was done by the field parties under the immediate direction of the chief of party.

CWA orders brought this project to virtual close on March 15, 1934. Before disbanding, each party closed its traverse on some well referenced mark. An example of such closure is the circuit at the extreme tip of Southern Maryland. It is referenced to the Coast and Geodetic control at the light house tower, and to the spire of St. Michael's Church, also a Coast and Geodetic reference point.

On disbandment of the field parties, equipment the property of civilian organizations was returned, and that owned by the Coast and Geodetic Survey was shipped to general headquarters.

Field notes were assembled in the computing office at the University, and a small corps of computers is now engaged in their reduction. The first circuit computed, the Kensington, closed within 1.5" per angle and 1 in 35,000 in distance, an accuracy well within second order work. The Coast and Geodetic Survey has furnished a theodolite for use of the computing squad

STATE OF MARYLAND GEODETIC SURVEY, CIVIL WORKS ADMINISTRATION

Report of Work Accomplished, Dec. 1, 1933 to March 15, 1934.

Number of miles traverse completed.....	365
Number of miles leveling completed.....	500
Number of monuments established.....	575
Number of bench marks established.....	615
Number of man hours worked.....	149,000

COST DATA

(a) Wages	\$92,640
(b) Materials	5,200

Total.....\$97,840

should it be necessary to field check the notes, but so far there has been little occasion for this.

A condensed summary of work accomplished and of costs is given in the table.

Although none of this work is available yet for public use, several commissions working in Maryland have sent their own men to College Park to abstract field notes covering the territory of their interest. Notable among these is the Washington Suburban Sanitary Commission, whose excellent network was described briefly above. Its responsible engineers state that fully 25% of the money which it spent on traverse and control surveys could have been saved, had the work covered by this article been available when the Sanitary Commission first undertook operations. The Maryland National Capitol Park and Planning Commission, which uses the Sanitary Commission network, also has sent men to abstract notes covering a proposed extension into the Cabin John area. Its engineers foresee very definite savings in engineering costs through use of the state controls available in that area.

Further Work Authorized

An order was sent, a few weeks ago, to State ERA administrators authorizing geodetic control surveying as a work relief project, which "has been approved and does not need to be submitted to Washington for review." The aim of the survey is to "provide base for topographic and other maps and starting points for all classes of engineering operations. It will be the basis for surveys of boundaries of private and public land, and will be a further step in surveying and mapping the country."

Triangulation and traverse for horizontal control is to have an accuracy of one in 10,000, and leveling an accuracy of .05 ft. times square root of distance in miles.

It will be necessary to provide office space, surveying instruments; forms for record books and computations; cement, sand and gravel for making monuments, and metal tablets for monuments; although the last and the forms may be contributed by the Coast and Geodetic Survey.

The personnel will comprise a supervisor—an experienced engineer to direct all work; superintendents, engineers, recorders, rodmen, chainmen, draftsmen, accountants and clerical assistants.

The writer is indebted to Professor Steinberg for the data on which this article is based.



Maryland civil engineers engaged in CWA Coast and Geodetic Survey Works.

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.

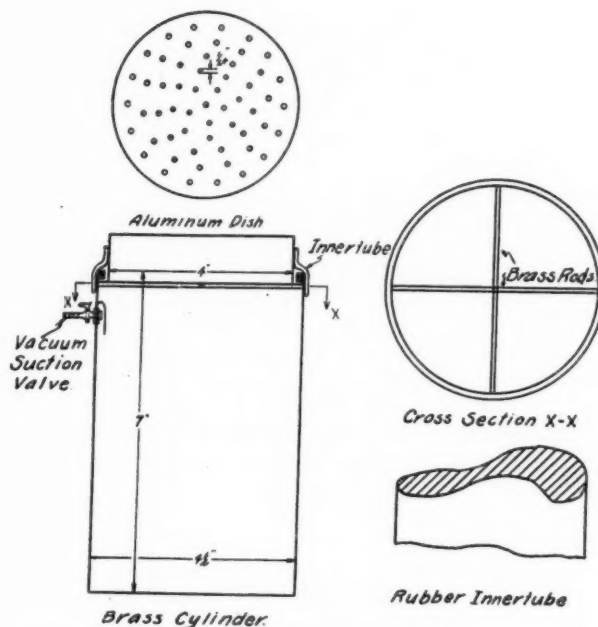
The Digestion Tank

SLIME growths in sewers cause trouble by retarding flow and retaining suspended solids; fragments or even large patches break loose and enter the treatment plant, where they clog screens, form ugly floating masses on the surface of settling tanks, interfere with mechanical scrapers in settling tanks, choke filter nozzles and stone beds, and in activated sludge plants give a cloudy effluent. In California, at least, the slime that gives most trouble of this kind is the *Sphaerotilus*. It grows best in sewage containing some dissolved oxygen and carbonaceous matter and which is neutral in reaction. Carbonaceous wastes from breweries, sugar factories, wineries, canneries, etc., favor its growth. Control measures include locating and cutting off supplies of carbonaceous wastes, reducing the oxygen content of the sewage, or making it strongly acid or alkaline. One community eliminated trouble by metering the water supply, which reduced consumption, thereby making the sewage stronger and using up the dissolved oxygen.^{C11-6}

Sludge solids estimation by a rapid and reliable method was studied by J. I. Smith, three methods being considered: "1—The centrifugal method, which is useful as a rough control test and requires about 5 minutes for completion; 2—the specific gravity method, which is more accurate than the above; requires from 5 to 7 minutes and more technical skill in manipulation; 3—the aluminum dish method, which involves vacuum filtration, drying, and weighing the solids direct, and is the most accurate of the three under all conditions" but requires 30 minutes. The third is preferred by the author and has been used about a year in the Calumet laboratory for determining suspended solids in aeration tank mixture. The procedure is: Place filter paper in flat-bottom aluminum dish with perforated bottom and dry in 105°C oven. Cool in a desiccator 10 min. and weigh. Wet filter paper and place dish in a holder arranged for applying vacuum; apply 20 mm. vacuum, immediately placing 10 c. c. of the sample in the dish; when water has been extracted, dry in 120° oven for 10 min. Remove dried sample to desiccator, cool and weigh. Advantages over the conventional Gooch crucible test are: use of 100 c. c. sample against 10 or 20 c. c.; drying by Gooch method requires 60 to 90 min.; aluminum dish method five times as accurate.^{C11-3}

Residual chlorine is not necessary in treating sewage, if there be immediate thorough mixing or a sufficiently long contact period. In some recent experiments, with a 7.5 minute period of contact and practically complete chlorine demand satisfaction but no residual, the average count of 20° organisms was reduced over 98%; but with only 60% of the chlorine demand satisfied and the same contact period there was a 95% reduction, and a 90% kill may be secured with only 30% of the chlorine demand satisfied.

To kill more than 99% of all forms of bacteria, 8.5 min. contact period suffices with complete chlorine demand satisfaction, but the same result can be obtained in 10 min. with 80% satisfaction, and in 25 min. with 40% satisfaction. For 90% kill, 2.5 min. suffices



Apparatus for rapid determination of solids, using aluminum dish

with 100 satisfaction, 10 min. with 50%, and 30 min. with 35%.

Most of the kill by chlorine is instantaneous, the rest being effected by the chlorinated combined with different substances in the sewage. Therefore immediate thorough dispersion of the chlorine in the sewage is important—the greater the amount of absorbing substances the greater this importance. "The question of obtaining efficient results with less chlorine resolves itself, therefore, into a matter of procuring better initial distribution, longer contact periods, or both."^{G11-2}

Air bubbles rising through sewage are surrounded by a film of sewage, which impedes contact of oxygen and sewage, according to Adeney confirmed by Schmidt. "With increased volume of air and more vigorous ascension of the air bubbles, the detention period and the diffusion are less. The small, slowly rising air bubbles at first give up more oxygen to the sewage, until the film forms and becomes thick. In bursting, each air bubble leaves a thin skin, which is the foundation for the building up of further activated sludge. Whether the skin consists of sewage colloids or of bacteria or of both needs further investigation."^{D11-10}

Self-supporting treatment—or nearly so—is reported from Herington, Kans. Since the new plant went into operation Dec. 13, 1933, the effluent has been sold to the Rock Island R. R. for use as boiler water in its shops and locomotives. The plant cost \$56,086. From Jan. 1 to Sept. the operating expense totaled \$2,094 (including pumping the effluent to the railroad tank, supplemented with creek water), while the revenue from the sale of this effluent and water was \$4,951. This corresponds to a yearly balance of \$3,809 to cover fixed charges, which amount to approximately \$4,000.^{G11-1}

The Henry process of precipitation developed by R. A. Henry, of Liege, for treating coal washing slurry, has been used for treating the sewage of Micheroux, Belgium, 100,000 population. Ground lime is mixed with the sewage to bring the pH to 11; the sludge settled out and immediately removed to a conical settling tank, where rapid consolidation of the sludge is effected by the use of frozen starch and caustic soda, and the sludge dewatered by means of a vacuum filter. The starch grains are cooled below 32° by placing them inside a refrigerator; if not so cooled the action is much slower and much more starch is required. The reason for this is not explained. For treating coal slurry, one ounce of starch is used per 1,000 gallons, and one ounce of caustic soda for 400 gallons. The amounts used for sewage sludge are not stated.^{D11-9}

Settling and compacting of **activated sludge** were studied by Rudolfs and Lacy, using sludge from the Madison-Chatham, N. J., and Tenaflly, N. J., treatment plants, with the following conclusions: Increasing aeration temperature increases settling rate; increasing settling temperature decreases settling rate. Pressure has little effect on settling, but suction increases settling rate. With increasing solids concentration, rates of settling and compacting are retarded. The greater the depth of the liquid the slower the settling rate; the greater the surface area the faster the settling rate and the greater the compacting, the latter irrespective of sludge concentration. Shape of container makes little difference in the percent volume occupied after 30 min. settling. The greater the angle from the vertical the less the volume occupied by the sludge after 30 min. settling. Continuous aeration of good activated floc showed a gradual decrease in volume of sludge settled. Repeated stirring and mixing was of little practical importance on subsequent settling and compacting. With increased septicity, sludge settles and compacts at a lower rate. Fresh solids added to activated sludge cause the mixture to settle and compact at a more rapid rate than activated sludge alone. The ability of activated sludge to clarify and oxidize affects the settling properties, even when mixed with fresh solids. Violent stirring of the mixtures affects the movement of the solids.^{C9-1}

Trickling filter flies, the name commonly applied to a species of Psychoda, are semi-aquatic. The male flies are 2.5 to 3 mm long, females 4.0 to 4.5 mm. The eggs are laid on the film covering the filter ballast, generally in gelatinous masses, and at 70° F hatch in less than 2 days. The larvae are white, composed of 7 segments, attain a length of 9 mm or more. This stage lasts 9 to 15 days at 70° F but only 8 days at 85°. It lives in the filter slime, eating decaying organic matter, molds, algae, and protozoa. It usually dies if deprived of air for 24 hours, but may survive more than 48. The pupa is yellowish, 6 mm long, and changes to the adult fly in 20 to 48 hours at 70° F. Male flies live only a few days; females up to 7 days. The flies are sluggish and make short flights but may be carried by the wind hundreds of feet. The total life cycle varies from about 7 days at 85° to 22 days at 60°. They generally emerge from filters in great numbers during the first warm spring days, disappear after the spring unloading of the filter and reach a peak in late summer, breeding as late as December in the northern United States. Larvae and pupae are most concentrated in the zone 3 to 12 in. below the surface but are found at all depths. Fly breeding is favored by open walls and surface ballast of large size, since both afford moist cavities for the eggs and pupae

unexposed to currents of liquid; and is discouraged by either serious clogging or thin film formation on the ballast.

Control has been attempted by introducing spiders, mites, Achorutes viaticus, etc.; by chemical repellants and insecticides (which must be harmless to the filter film); and by physical control, such as burning, flooding, drying, using tight walls and small surface ballast, or using glass-overs or other covers. Drying seems to be impracticable, but the other methods of physical control offer more promise than either biological or chemical. Use of small surface ballast and tight walls deserves further study.^{C11-8}

Ter Meer centrifuges have been undergoing development at the Frankfurt-am-Main sewage works during the past two years and now, according to the "Gesundheits Ingenieur", the improved model reduces the water content of raw sludge from 92-93% to 70-75%; of activated sludge from 98% to 78%; and of a mixture of the two from 93-95% to 70-75%. The separated liquor contains about 1% of "pollution." The Frankfurt centrifuge is 2 meters diameter and has a capacity of 10 cu. m. per hour of raw sludge, two machines dealing with about 300 cu. m. of 92-93% sludge in 15-16 hrs. Sludge is automatically drawn into a centrifuge drum on the opening of a valve by the oil control apparatus, which closes when the drum is full and begins to revolve. A tube protrudes automatically into the drum to draw off the separated liquid, and when this becomes very turbid a scraper blade automatically removes the sludge, the tube and scraper retreat automatically and the process is repeated.

Inclusive of the building and pipe lines, the total cost of two such centrifuges is at most 80,000 to 100,000 reichmarks, and each is run by a 20 hp. engine. Maintenance costs are confined to occasional renewal of a scraper blade costing a few cents.

At Frankfurt the fresh centrifuged sludge has for several years been used as a fertilizer without further treatment, with no odor nuisance; and has a higher fertilizing value than digested sludge.^{D12-8}

Sludge gas at Toledo, O., produced in 1933 totaled 67,701,800 cu. ft. Of this, 24, 543,500 cu. ft. was used to heat the buildings and the digesters (about the same amount for each) and 43,156,500 cu. ft. was wasted; the last varying (by months) from a minimum of 2,078,000 in March to a maximum of 5,113,600 in September. This would, if used in gas engines to produce current, produce 30% more power than is used for pumping the sewage (which cost \$19,259 last year); or 75% more if heating be done by exhaust gases from the engines. This calculation is on the basis of 650 B.t.u. per cu. ft., 1 h.p. h. from 10,000 B.t.u. of gas; or, with 20% loss, 25.75 cu. ft. of gas per kwh on the switchboard.^{E12-2}

Overflow liquor from sludge digestion tanks is one of the most difficult of sewage treatment problems, especially where activated sludge is digested with the raw. The character of overflow is influenced by: 1. That of the solids removed in the sedimentation tank—increased fineness of these means increased solids in overflow; 2. Addition of activated or secondary sludge, which considerably increases solids; relieved by increasing digester capacity to at least 3.0 cu. ft. per capita, assuming that activated sludge is thickened before digestion; 3. Pumping excessive amount of liquid sludge to digester—relieved by concentrating the sludge in the primary settling tank, or in a separate thickener tank before digesting, septic action in the latter being prevented

by adding a small amount of chlorine; excess activated sludge may be wasted directly to the thickener; the thickener overflow is generally clear; 4. Increasing rate of digestion increases solids in overflow by gas flotation; the larger the tank area, the less the trouble from this; 5. Violent agitation by stirring or pumping raw sludge to digester; 6. Increased temperature, as by sudden rise in air temperature in case of unheated tanks; in Aurora, Ill., non-settleable suspended solids in overflow averaged 107 ppm when digestion was at 90° F, and 451 ppm when digested at 130°; 7. Design; adequate supernatant liquor zone, or two-stage digestion improve results. In the latter, most of the gas is released in the first stage, with little gas agitation in the second; short circuiting of raw sludge to overflow is reduced to a minimum; and the more complete digestion reduces the solids in the overflow.

Overflow liquor can be disposed of by discharging it with digested sludge onto drying beds; treatment by chemicals, such as lime or ferric chloride (questionable); storage in settling tanks; disposal on sand beds; returning to raw sewage. The last is practically universal where only raw sludge is digested; but in case of activated sludge plants may build up a circulating load of unsettled solids.^{C11-7}

Creamery waste purification investigations in Iowa led to the following conclusions: Every possible effort should be made to reduce the concentration of milk waste constituents leaving the creamery; staggering discharge of different waste-producing units is often of advantage. Degree of purification necessary is dependent upon ultimate disposal of effluent. If discharged into a dry ditch, highly purified effluent, with low oxygen demand and preferably well nitrified, is necessary; chlorination desirable in some cases to retard or prevent growths in ditch. Where discharged into sewers, only elimination of most of the acid-producing constituents is necessary. Trickling filter can be operated at rate of 1 mgd per acre; possibly more, but with danger of reducing filter efficiency by clogging.^{C11-11}

Trickling filter ventilation from the bottom seems desirable when treating skim milk waste at the rate of 840,000 gal. per acre per day with 8 to 10-hr. rest periods. Test filters were operated both with and without bottom ventilation, and it was shown "definitely that elimination of bottom ventilation resulted in a rapid decrease in the purifying efficiency of the filter as shown by marked reduction in nitrates, increases in ammonia, organic nitrogen and acidity, and a remarkable increase in the biochemical demand of the effluent," and in clogging of filter. Neither washing nor chlorinating the filters improved the effluent so long as the bottom vents remained closed.^{C11-12}

Minneapolis-St. Paul treatment plant recommended tentatively by an engineering board, to treat 134 mgd, maintaining dissolved oxygen in the river at 2 ppm. for 90% of the time during the summer months, and always above zero, comprises plain sedimentation, supplemented when necessary by either chemical precipitation or activated sludge treatment of 1/3 to 2/3 of the sewage; with sludge treatment in digestion tanks, storage tanks, sludge-washing tanks and vacuum filters. Dewatered sludge for the present can be wasted on the 450 acres of plant site. Favoring the chemical treatment are lower cost of construction (\$3,241,000 as compared to \$5,034,000 for 1/3 activated sludge treatment) and of operation and maintenance (\$285,200 as

compared to \$301,800); ease and economy of adjustment to meet needs of varying stream conditions; and ability to use most of the special construction features for activated sludge treatment if change to this should seem to be desirable.^{E12-1}

Iron pipe for sewers at Bowling Green, Ky., and in the Cleveland sewage disposal plant are typical instances.^{G7-182} The former, completed in April, 1934, was part of the sewer work done with a R. F. C. loan of \$630,000, which will be repaid through sewer rental charges against property owners. All stream crossings, sewers in stream beds, railroad crossings, and the 36" main interceptor, where it is above ground, are of cast iron pipe. The 1350 ft. of interceptor, supported on concrete piers 12' apart, weighing 300 lb. per lin. ft., with hydrotite joints, was let at a price considerably below the bid for reinforced concrete pipe on piers spaced 15'.

Bibliography

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; n, note or short article; t, technical article.

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The Editor's Page

Prepare for Winter Highway Dangers

According to a recent publication of the Iowa Engineering Experiment station, skidding was a contributing factor in 24% of all highway accidents in Connecticut, and in 7.5% it was the direct cause. In Connecticut, in 1933, 48% of all skidding accidents occurred during the four winter months; and in Iowa 82% of all skidding accidents occurred during the winter months.

The highway engineer cannot, between now and winter, change the characteristics of his pavements, but he can take steps to reduce the dangers that come from slippery pavements. Sand and cinders treated with chlorides can be stored for emergency use on certain hills where experience has shown the likelihood of frequent danger; a sand-spreader applying grit much more widely to highways when ice conditions are bad might be an innovation, but it could be done at a comparatively small cost. It is even possible that, like snow removal, it might pay for itself through increased winter travel and consequent increased gasoline tax income. And proper snow removal practices must not be forgotten. Clear the roads wide enough so that cars can pass with a reasonable margin of safety.

Planning for Increased Population

In planning for any public service it is necessary to take into account the probable growth of population and provide capacity for five, ten, fifty, etc. years ahead. This applies to water supplies, sewerage systems, streets and other traffic provisions, school buildings—everything used by the public in common.

A few years ago the population of the United States was doubling every 30 years and cities were growing twice as rapidly as non-urban areas. But now that immigration has been greatly restricted, the birth rate fallen, and growth of cities at expense of country reduced, the same rules will not hold, and capacities of public facilities based upon such anticipations will be so great as to be uneconomical in both first cost and operating expenses.

A recent bulletin of the U. S. Dept. of Agriculture says: "For 20 or 25 years the population of the United States may continue to increase though at a much slower rate than in the past. This increase is likely to be followed by a decrease in population, which will become more rapid with the passage of time. . . . Migrations from rural areas to the cities can no longer prevent permanently a decline in the population of the cities, unless the birth-rate rises or the restrictions on immigration are relaxed."

There will of course be exceptions; some cities will probably increase 100% or more, but at the expense of other cities which will decrease. But such unusual increases will gen-

erally imply unusual prosperity, which can afford to increase inadequate public facilities. Unless there is almost certainty of such increases, wise economy in planning for all city utilities will anticipate the gradual reduction in population referred to. The curves of anticipated population, instead of being concave upward will be made concave downward, becoming horizontal in 20 or 25 years.

There must of course be allowance for increasing per capita use of water, electricity, etc., and for increasingly general installation of sewerage, plumbing fixtures, sewage treatment plants, etc. But money of the impoverished present should not be wasted by planning capacities which will never be required; or which if they are required, can better be afforded by the more opulent future whose greater wealth makes them necessary.

Appropriate Planting Effects for Grade Crossings

In this era of roadside beautification, proper planting effects for grade crossings have been woefully neglected. We would suggest that an eighth of a mile from the crossing, there be voluminous plantings of red-berried barberry, tomatoes, Judas trees, and other properly colored plants to warn the driver. Just beyond these, there should be tastefully arranged, so as to bring home to the motorist the dangers of the crossing, prostrate junipers, mincemeat bushes, bleeding hearts, and lilies of the valley. And, since most of the crossings are rough, a special grouping of trembling aspen might be arranged as a warning signal. It has also been suggested that the signs customarily erected to indicate a railroad crossing, might be faced with linen crash.

But seriously, grade crossings are dangerous. Elimination of crossings costs money, but so do accidents. And elimination of grade crossings might well be included in the work program of every community where they exist—and there are very few fortunate ones where they do not.

To Our Readers, a Merry Christmas and a Happy New Year

The construction industry has not yet recovered from the hard days of the past few years, but conditions are undoubtedly better this Christmas than for the past four years. Here's wishing a Merry Christmas and a Happy and Prosperous New Year to all, with a couple of brand new big jobs for each consulting engineer; a raise in pay for every city, county and state engineer, superintendent of water works and other municipal employee; a big job with good weather and no labor troubles to the contractor; and plenty of orders for the highway equipment and materials manufacturers.



A matter of

Honor



WHEN motor fuel taxes were first imposed, motorists paid them willingly because it was either promised or implied that they would be used for improving roads and streets.

Motorists don't mind paying money for roads which will help reduce their car operating and repair costs. But when these funds are diverted to other purposes, it means breaking a promise—it is a matter of honor!

Even as an emergency measure, the diversion of "gas tax" funds for "relief" and other pur-

poses is not only unjust, it is uneconomic. Highway employees, engineers, contractors and others are thrown out of work, and the investment in highways already built is jeopardized by insufficient maintenance.

Let's keep the gas tax funds where they belong—for our roads and streets.

ARMCO CULVERT MFRS. ASSN.
MIDDLETOWN, OHIO



Armco

DRAINAGE IS GOOD ROAD INSURANCE

When you need catalogs—consult the *classified READERS' SERVICE DEPT.*, pages 75-77.

"... make straight in the desert a highway. . . . Every valley shall be exalted (filled) and every mountain and hill shall be made low: And the crooked (roads) shall be made straight and the rough places smooth." Isaiah, 40: 3-5.

Highway Construction for Unemployment Relief

The possibilities that exist in the public works field to provide relief for the unemployed, to promote national recovery, and to secure at low cost structures of permanent usefulness to the community are outlined in the following pages.

The Editors invite suggestions, comments, criticisms, and questions.

PUBLIC WORKS Magazine, 310 East 45th Street, New York

Devoted to the Sound Construction of Sound Public Works

FROM more years of experience than we care to recall, and with many and broad contacts in engineering and in the public works field, the editors of this magazine offer suggestions for relief through employment on projects based on the needs and welfare of the community. These suggestions spring, not alone from engineering experience, but also from close contacts with the utilization of labor, both CWA and ERA. We know them to be sound, and we believe that, if carried out on a sound basis, they will assist materially in meeting many of the problems that confront us today.

We believe the aim should be to assist those in need of work, to promote national recovery to the fullest extent possible, and to produce structures which will contribute to the future health, comfort and prosperity of the community which they were designed to serve.

The Types of Work

BROADLY speaking, these projects include maintenance and construction of highways, their drainage and adequate bridging; the building of sewers, sewage treatment plants, and water supply systems; the safeguarding of water supplies; and

the provision for other necessary public projects.

This issue of PUBLIC WORKS will be devoted largely to outlining in some detail useful work relief projects, which are or should be a part of a sound highway program. These projects meet the requirements of being "useful and of sound public interest." They should increase the safety, com-

fort and volume of travel on our highways, and should also lay the foundation for future highway construction *as it may be needed*. In succeeding issues, other public works data will be presented, including those suitable for winter or other seasonal work.

Funds for Such Work

OUR reasons for treating principally of highway construction in this issue are grounded in the present controversy over the diversion of highway revenues for other purposes. In many states these highway taxes have become unfairly high, but sufficient revenues from them are no longer used for needed highway construction and maintenance. They are being diverted to other purposes—often to direct relief—with the result that highway work has been cut down, throwing out of work more than a million men normally engaged in this field, and because of the requirements for the maximum use of hand labor on such road work as is still being carried on, thousands of employees in highway equipment manufacturing plants also have been without employment.

It is our purpose to show in the series of articles that follow, first, that properly planned and executed high-



Cover page of California Highways and Public Works

way work affords exceptional opportunities for relief labor; second, that such employment is but little more costly than direct relief, and no more costly than many utterly worthless projects heretofore carried on; third, that the utilization of all gasoline tax monies in this way will take a large number of men from relief rolls, promote national recovery, and meet many of the objections now being made against diversion; fourth, that such properly planned highway projects will bring back to the community, within a reasonable time, every cent expended upon them. And, fifth, we shall attempt to outline some of the worthwhile jobs of this type that are waiting to be done in every community in the nation.

Highway Needs

OUR present highways require continual maintenance, just as does the automobile that runs over them. A very large proportion of our roads are unimproved—yet some one uses every mile of these roads. On the user of such unimproved road is levied a crushing burden. This toll charge of the unimproved road can not be diverted but it can be eliminated. An improved road surface, or sometimes



NOT MUCH LEFT FOR ROADS
Courtesy of Concrete Highways and Public Improvements

just drainage and reshaping will do that.

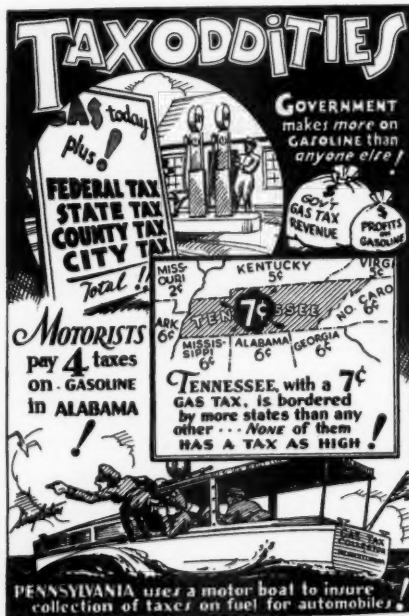
While hundreds of thousands of miles of dirt, dust or mud roads exist, road toll taxes (the gasoline tax) should not be diverted—not even for relief—because relief can surely and most economically be obtained through highway work.

The Easy Way in Relief

THE easy way in relief is the direct cash relief—the dole—call it what you will. Investigations, payments, grocery orders, all are easy to do. There is no responsibility for work done or to be done. There are no obligations to make decisions regarding plans, or to take responsibility. Naturally the professional relief worker, skilled in the routine of the direct, or cash, relief method prefers it to the unknown and seemingly baffling problems of hiring, working, planning, digging, building, and the myriad problems of construction.

Yet it is the lazy way out. The relief is only temporary; the effect on those who are the objects of this charity is tremendously depressing; no worthwhile good is accomplished. There is no progress in national or local recovery.

Perhaps a few spend their wages from work relief, not on food or clothing, but on drink, amusement, gasoline, radios, or other materials not generally accounted among the necessities of life. Again it is the easy way, but far from the right way, to base a policy of direct relief on such a flimsy reason. It is the routine, the bureaucratic, mind that does this. The



RIDING A WILLING HORSE TO DEATH!



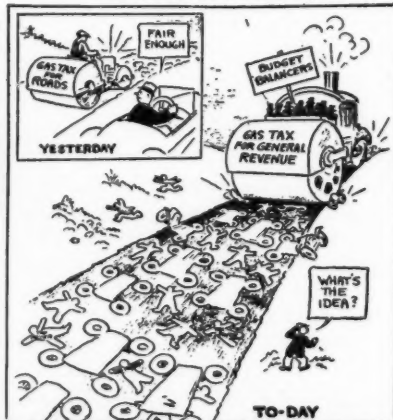
Why They Call It a HIGHway!



Tomorrow's Motor Car—If Legislators Were Designers

The cartoonist looks at the highway tax problem

THE COLOSSUS OF ROADS



sound, though perhaps more difficult way would consider the greatest good of the individual and of the state alike, and would carry through that way, despite such minor obstacles as these.

To Work or Not to Work

DIRECT relief proponents have stated that about \$5.50 per week of cash relief will suffice. To this add roughly 10% overhead. The community gains nothing, but loses all. The individual gets nothing but a living and not much of that.

We should greatly prefer to work men on a highway or a street at 30 or 35 cents an hour, 8 hours a day, 3 days a week, if the money must be stretched to go very, very far. For this, the expenditure will be \$7.20 or \$8.40 per week. Add even the 10% charge for overhead for the relief organization, and the cost is but little higher than for direct relief.

Yet the returns to the individual and to the community are so greatly increased, as to justify the increased expenditure, many times over. But supposing there are no funds above the bare \$5.50 per week? Is it not better to have a man work at 35 cents an hour, 8 hours a day, 2 days a week, or 30 cents an hour 6 hours a day, 3 days a week—and *EARN* that money.

The money is earned because something is given in return. The community may have a new highway that begins to produce a revenue from gasoline taxes on the day it is opened; or it may have only the comparatively cheap foundations of a road—grading, widening, straightening, drainage, bridging, which in the future will save every dollar that the taxpayers have put into it to help their needy fellow-citizens.

Engineers Are Indispensable

THE writer is familiar—and doubtless many others are too—with parks and other areas where CWA and ERA workers have been employed that were barred to the public because the relief directors and the municipal officials did not dare to have the taxpayers see how little work was being done and how unimportant it was.

A year ago, the generally aimless work of the CWA was regarded as unfortunate but perhaps justified by the immediate necessity of the moment. That excuse no longer holds. There has been time to plan; engineers are available to guide the workers into channels and onto jobs where their labor will bring profits to the state. Engineers, like laborers, clerks, and every other group have been out



Road work for the unemployed in Onondaga County.

of work. They, too, must have relief. So the money paid to secure adequate engineering is an item, just as much as the laborer's pay, in solving the problem of unemployment.

Engineers should be in complete charge of relief work projects. The requirements of sound engineering are based on immutable scientific principles which cannot be changed, whereas the routine of relief procedure often can be changed without disaster.

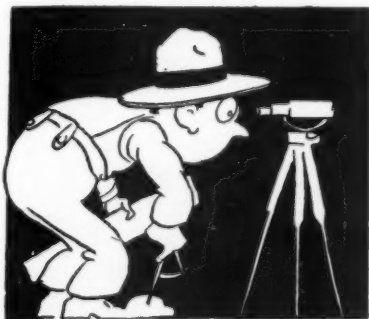
PWA Road Work

A YEAR and a half ago the Public Works Administrator turned over to the 48 states 400 million dollars for highway construction. Since

much in direct labor costs on CWA and ERA projects.

It is unfortunate that no Bureau at Washington has yet taken the time to compile accurate results of these campaigns to create work and produce an upturn. Perhaps it is too early to have even fairly complete figures, because the PWA is still going on, bringing business to thousands of factories and putting men on the payrolls of manufacturers, contractors, and other employers of labor. The CWA is past; the ERA is passing.

The editing of this magazine brings us into close contact with the entire public works field. Our knowledge of this field, and our contacts with it have convinced us completely that the money put out through the PWA, and spent under normal conditions of construction, with the use of a reasonable amount of construction machinery, has done far more toward national recovery than have the much larger sums spent in hand labor work.



The engineer may look like this to the uninitiated but he is an indispensable factor in good construction.

that time an additional sum aggregating about half that amount has been allotted to communities on a loan and grant basis, for other public works construction. The CWA and the Emergency Relief Administration has spent perhaps two or three times as

And Why Not?

THE highway authority of the nation—the Bureau of Public Roads—has traced out the highway dollar and has shown that around 91% of it goes to labor, even when using the most modern of equipment. And why not? The road roller, the concrete mixer and the tractor, take labor to produce. Labor is needed to mine the ore, the coal, the limestone; to produce the steel; to turn and temper it to produce the finished product; and labor must run the railroads that transport the coal, ore, and finished



Road under construction, using CWA labor

products. The successful operation of the railroads, for instance, is important to the well-being of the community. Railroad labor, railroad investors, life insurance companies, and the individual investors would be ruined otherwise.

Recovery cannot be obtained by taking men from our factories and our railroads — from industry — where they were making perhaps \$5 a day or more and putting them in an ERA job at 30 or 40 cents an hour.

More Roads—More Cars

IN every rural community there are folks who say "I'd like to have a car, and I'll get one when they put a good road by my place. But the way the roads are now, I can't get down to the main road more than a few months a year."

It costs no more to maintain a good rural road than a poor one—often less. The average car today is taxed more than \$50 a year, counting all forms of taxation. Two or three cars per mile of low-cost rural highway may yield a profit to the community.

The Viewpoint of Local Industry

IN every village and community located on a good road, every third or fourth resident depends to some extent on good roads for an aid to existence. These include the local garage, the "hot-dog," "red-hot" frankfurter or sandwich stands, the home that takes in tourists, the filling sta-

tion, the produce stands, and the countless other activities that human ingenuity has devised to make a little income.

These are local industries just as surely as the local factory that makes blades for road graders, or that produces tractors, road rollers, or stone crushers. They are dependent upon good roads for existence. The more roads, the more travel, and the more



The artist's view

widely are distributed the benefits of good roads.

And the local farmer with eggs or milk to sell is a local industry dependent largely on good roads. So is the local creamery with milk or cheese to ship. A few miles of bad roads place on them a tremendous handicap. The cost of the poor road tax is far higher than the cost of the good roads tax.

Factory Workers on Highway Construction

IN countless small cities of the middle west, where there are factories which for years have manufactured equipment to build roads better and cheaper, we see these factory workers wielding a pick and shovel—"manicuring" highway slopes or cutting grass by hand at 30 or 40 cents an hour. They might far better be making the machinery in their own shops at a living wage, while others were building better roads at a fraction of the cost. Individual, state, city and capital would benefit.

—And the Schools

MONEY for schools is necessary. We must train our children to be good workmen and good citizens. It costs a lot. We should get a dollar's worth for every dollar we spend for schools. Consolidated schools increase attendance 10 to 15% and often double the number of promotions and of high school graduations. In consolidated schools, the cost of transportation of the children is a large item. One bus on good roads will do the work of two on poor roads. Let any school compute the cost of transportation per mile for each pupil and see what effect good roads will have on the school budget.

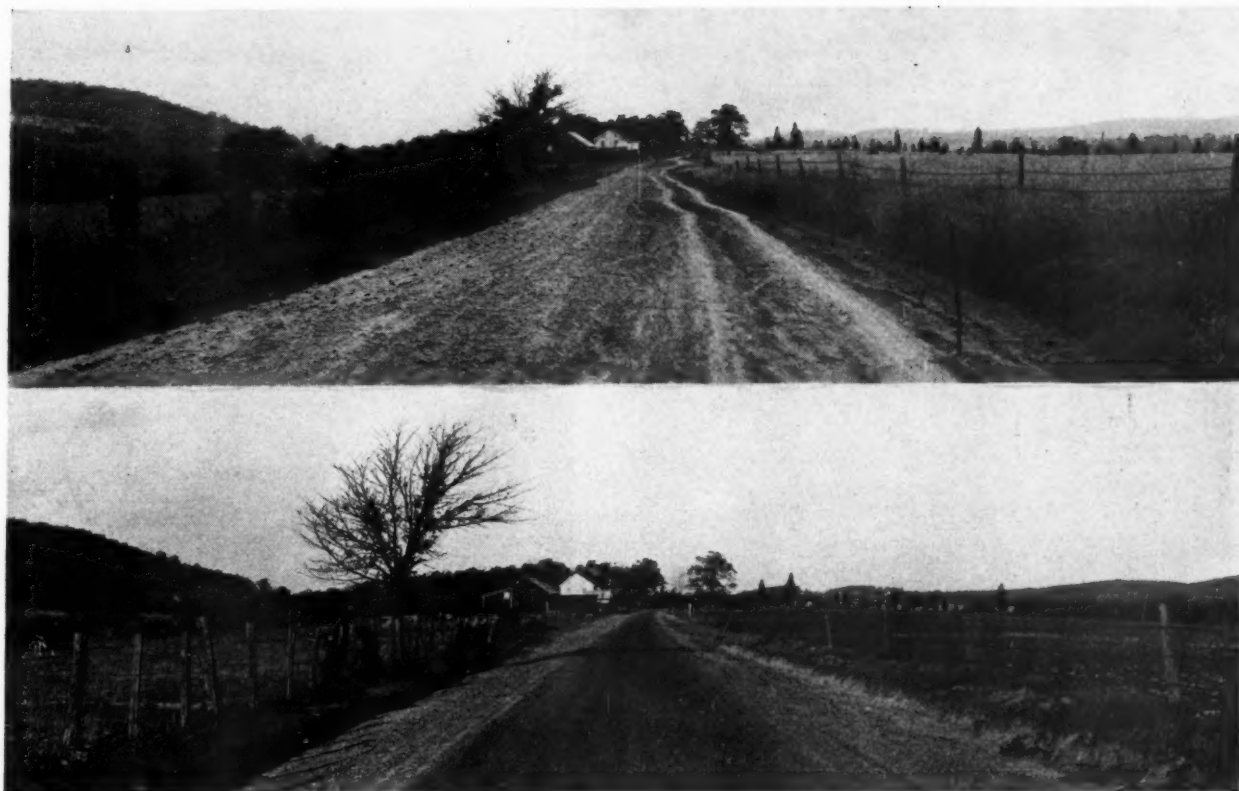
Unemployment Relief With Highway Funds

IN the foregoing paragraphs, we have tried to outline the possibilities of employment on highway work, and to show how it would benefit community, individual and nation alike. Let us now see what has been accomplished in two places by doing this very thing.

ONONDAGA COUNTY, N. Y., solved a major unemployment problem by putting from 6,000 to 10,000 men at work on local roads of the stabilized or "soil concrete" type, described hereafter. Local materials,



A stabilized road before and after, and a section of the finished road



A Pennsylvania Rural Road before and after improvement with a low-cost pavement made it travelable in all weathers.

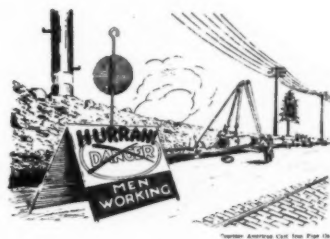
local labor, local trucks and local teams were used, as well as the more modern equipment necessary for sound highway building. The roads were widened, graded, the sharper curves cut down, and culverts, drains and bridges built. The surface, in which local gravel and clay were carefully proportioned and mixed, was bound together with calcium chloride. Such roads will carry local traffic of the present volume. If and when traffic becomes too heavy for this surface, a top of asphalt or tar or concrete can be added at a relatively low cost, since much of the most costly work has already been done.

Work of Permanent Value

THE work accomplished by the utilization of those otherwise without work has, at a cost but little more than that needed for direct relief, provided structures of real and permanent value to the citizens of the county. Through increased gasoline usage and more motor vehicles, these roads eventually will return to the state and the county much of the money spent on them; in the meantime, their construction has opened up rural sections to markets, and considerably increased land values in the areas served. And 10 or 20 years from now, this work will still be bringing returns on the money expended. This can never be the case with cash relief.

What Pennsylvania Has Done

FOUR years ago the state of Pennsylvania embarked on a low-cost highway program designed eventu-



Time to change the sign

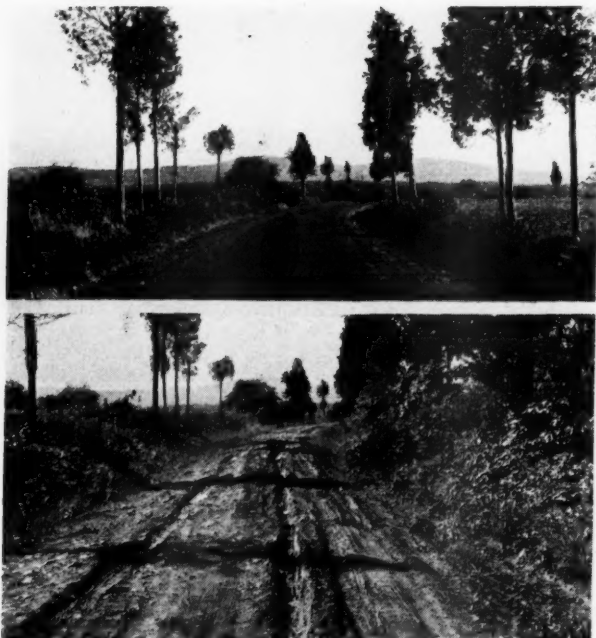
ally to bring a good road near to almost every farmer in the state. Since then 20,000 miles of highways have

been built. Each year, from 55,000 to 70,000 men have been given employment on this construction program directly; and in addition many other thousands have found work indirectly, but as a direct result of this highway program. Construction work has been done, not by hand labor and with hand tools, but with the employment of modern machinery and equipment, thus contributing to national recovery.

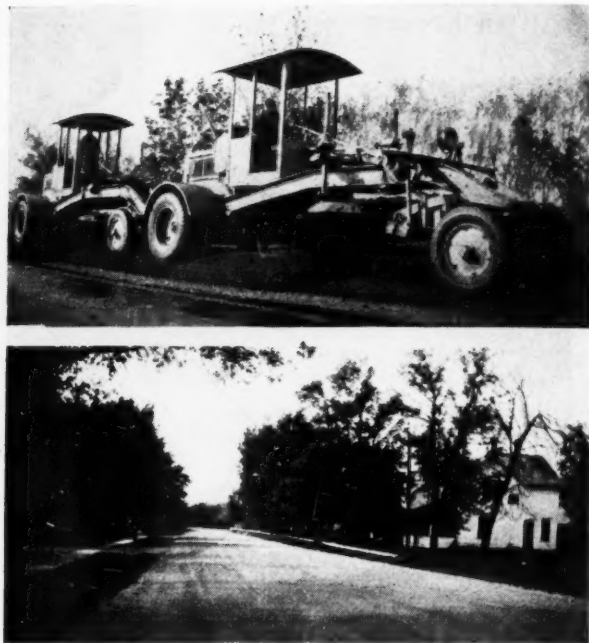
These rural roads of Pennsylvania have averaged around \$6,000 per mile in total cost. In giving employment to 70,000 men, a comparison may be made with the 161,454 persons on the ERA work program of New York State for the week ending Oct. 11, 1934. The Pennsylvania program



Highway construction made possible by PWA Funds gave employment to many.



Another "before and after" in Pennsylvania. This road cost \$6,000 a mile—mostly for labor.



Road work gives employment and increases land values.

cared for approximately forty percent of the number of men on the New York rolls. The cost of New York relief was at the rate of \$140,000,000 per year; yet Pennsylvania spent less than 40% of the New York expenditure and accomplished a job of outstanding value to its citizens.

The Pennsylvania roads were largely of local materials, built with local labor which was properly equipped

for the work with tractors, trucks, graders, rollers and other necessary highway equipment. After grading and preparation of the roadbed, broken stone was placed and rolled, tar or asphalt applied, the whole rolled and a seal coat of tar or asphalt added with stone chips. The result is shown in an accompanying picture, illustrating the before and after of a typical rural road.

laid, the third "stage." But a new industry establishes along this highway, which adds greatly to the volume and the weight of traffic, and a concrete or other heavy duty surface is finally constructed.

Thus, there have been four stages of construction, in each of which the initial cost was kept to a minimum with a minimum-cost surface until traffic demanded a heavier one.

The "Stage" Construction of Highways

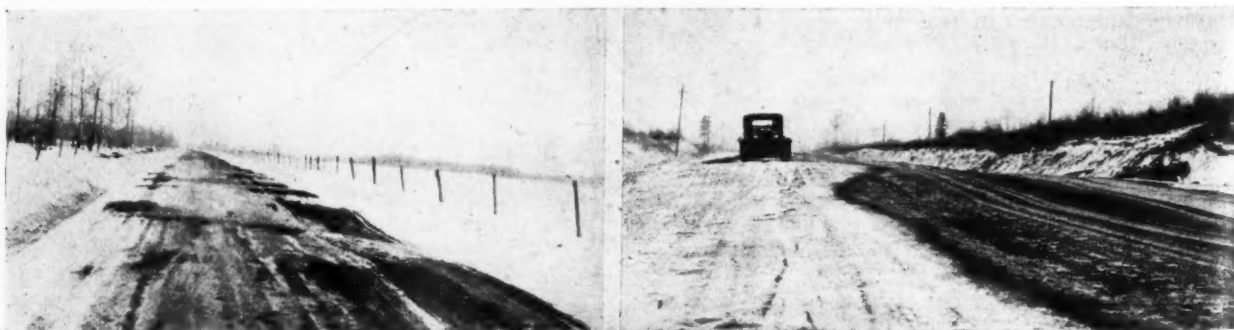
IT IS not always possible to tell in advance what amount of traffic will come upon a road. If a road provides a shorter or more favorable connection between two or more important points, it may draw largely from other existing roads, or may create considerable new traffic. Because the probable traffic is unknown, and may be great or small, it is desirable to construct the road of such materials that it can be cheaply and easily improved to carry new or

heavier traffic when this is necessary.

In its first "stage" the highway might merely be of earth, smoothed, graded, properly drained and stabilized with gravel. The traffic becoming too heavy to be economically carried by this surface, it may be found desirable to place a thin bituminous "surface treatment" on the original surface. But even this does not prove sufficient to carry the continuously increasing streams of automobiles and trucks, so a mixed-in-place surface is

Determining What Kind of Roads

WHILE "stage construction" may afford a means of avoiding penalties from poor guessing on traffic volumes, it is better to know as far ahead as possible what traffic is likely to develop. Moreover, in a far broader way, this same information is desirable so that future highway plans can be made and the roads with the heaviest volume of traffic surfaced first. A traffic survey will give such data, and will also provide employment for a number of men.



How frost heaves affect poorly drained roads.



On the left, a good type of mud road; on the right a sand road. Mix these components properly for good roads

Traffic Counting Stations

TRAFFIC counting stations are first located, the sites being chosen to give fair and representative results on the various roads in the area to be studied. Since the cost of making a set-up for the study, and the cost for equipment and materials to be used is almost negligible, a considerable number of such points may be selected which will give a clear picture of traffic conditions through the area.

Two men will generally be sufficient to take the traffic count at each station. If they work 8 hours a day, two shifts, or four men, will provide a 16-hour count on the traffic passing this point. Except in unusual cases, this is all that is necessary. Sufficient data are available on the relation between day and night traffic, so that a 16-hour count, and in many cases a 12-hour count, will give very reliable information on the volume and kind of traffic. If the men are to work but 6 hours a day, a 12-hour count may be made.

Shelter of some sort must be provided, and also transportation unless local men are employed, which is often feasible since many or most of the counts will be taken on the outskirts of cities, villages or towns, at principal cross-roads, and similar places. Four men can be given employment at each point.

Traffic Volume Relations

THERE is a definite relation between traffic volumes of weekdays and on Sundays, throughout the season. It is possible to get a fair picture of traffic conditions by making a count at each point covering only one day, though it is preferable to do the work more thoroughly than this. Variations in traffic volume, due to seasonal influences, should also be checked.

Commercial and Foreign Traffic

COMMERCIAL, or truck and bus, traffic tends to indicate the importance of a road as an artery of commerce, but the absence of such traffic



may only indicate that commercial vehicles are using a less direct, but better road. The number and weight of commercial vehicles should be

noted carefully so that the designer will know what loads he must design his roads to bear. The volume of foreign traffic (cars from other states or other nations) is always of interest and should be noted on the survey.

Other Uses of a Traffic Survey

THE data obtained from a traffic survey is of great importance in designing highways and of still more importance in connection with the general layout or design of a highway system. It also affords an opportunity to get exact figures on maintenance costs and to compare maintenance costs of various pavements types. And in addition, employment can be given to a number of people, principally of the "white collar" type.

Earth Roads

SOMEWHERE near 80% of the nation's highways are unimproved, that is, they are dusty or muddy, depending upon the season, and rough all year around. On some of these the amount of traffic does not now and probably never will justify any considerable degree of improvement; yet even on these a comparatively small amount of well-directed work will provide highways that are passable during most of the year, and are good, compared to the average rural road, during some seasons.

Drainage is perhaps most important, so that the road will have a solid and substantial foundation; filling of mudholes; safe bridging of streams; straightening; widening, where necessary; some grading to eliminate particularly dangerous spots; and improvements of a similar sort based on local conditions and local needs—all will yield big dividends in community betterment and good-feeling.

By far the greater part of the work involved comes under the head of direct labor, but a few simple pieces of equipment will tremendously increase the efficiency of the men and produce a better highway. A light tractor, a bull-dozer or scraper, a blade grader and a small concrete mixer are the only pieces of equipment needed.

Roads of "Soil Concrete"

YET, roadbuilding science has been able to make durable and satisfactory roads out of such natural soils, at very low cost. The Onondaga County roads already mentioned were of this type. The first job is clearing and grubbing to afford a wider permanent roadway; this is followed by laying permanent ample culverts, and ditching, the material from the ditches being used in building up the road grade. The rough grading is completed by blading and rolling, if necessary, and guard rail is placed at necessary points.

Natural soils are very rarely found combined in the proper proportions in nature. If too much sand or gravel is present, the road lacks cohesiveness; if too much clay is present, the road lacks stability, and becomes muddy in wet weather. If these elements can be united in just the right proportions, a firm and substantial road results.

Therefore, the material on the road is examined, and gravel and sand or clay added, as may be necessary to produce when thoroughly mixed with a harrow or a grader a stabilized surface. When calcium chloride in small amounts is added the resulting mixture becomes so tight and firm as to resemble concrete, whence the name "soil-concrete."

Such wearing surfaces can be constructed for a few hundred dollars a mile, and they will bear ordinary rural traffic with small necessary maintenance costs. Moreover, if it is desired later to construct a heavier surface, this can be done very economically, because the preliminary work of grading, ditching and widening has already been done. Up to the end of 1933, a total of 335 miles of such

roads had been built in Onondaga County, the construction utilizing unemployed labor and creating a markedly favorable public reaction.

Gravel Roads

GRAVEL is obtainable locally in many portions of the country.

Excellent roads, suitable for light traffic, can be constructed cheaply with it. Ditches and drainage outlets should be made ample, subsurface drainage installed where necessary, the road widened, if desirable or possible, and the alinement improved. With a grader, ridges of earth can be thrown up at the sides, and gravel deposited in depths of 4 to 16 inches. On a well-drained road, even light applications of gravel will carry the usual farm traffic, but it is better to make the gravel layer 8 to 12 inches thick.

Well constructed roads of this type are a good investment, because as traffic increases, a light or heavy surface treatment can be added cheaply and as needed, resulting in a smooth, dustless road, suitable for a medium concentration of traffic.

Bituminous Low Cost Roads

IN THIS discussion, which will omit the details of construction, low-cost roads will be considered as those which involve the use of asphalts, tars or emulsions for binding agents, and which do not cost more than 60 cents a square yard under average conditions. Such roads may be classed under the following groups: Treatment of natural soil roads; surface treatments for gravel,

macadam and other low-type roads in order to reduce maintenance and improve riding qualities; and road-mix and retread surface, which are the heavier of these groups and able to carry large volumes of traffic.

Requirements for Low-Cost Roads

FROM the viewpoint of the road user, the following qualifications are necessary for all surfaced and treated roads:

- They must have a smooth and safe riding surface;
- They must be serviceable the year around;
- They must be satisfactory and safe



Low cost road construction in Michigan; bituminous top on gravel.



Making an oil top road.

in regard to curvature, crown, grade and bridges.

From the viewpoint of the unemployment relief director, these roads have the advantages of being relatively simple to build, and the construction processes employ equipment that is cheap and that is normally used for general highway maintenance, and should thus be a part of the equipment of any city, county or state. Moreover, such road construction offers an excellent opportunity for work relief.

Engineering Skill Is Required for Direction

IT USUALLY takes more skill, knowledge and judgement to build a good low-cost road than it does to build some high-cost types. A half-built low-cost road is money thrown away. Engineering advice, proper equipment and materials, and correct methods are, alike, essential. If doubt exists as to what practice to follow, advice should be obtained from someone who knows. Guessing gives poor results. Experience or competent advice gives good results, but the latter is cheaper in the end.

Essentials in Low-Cost Construction

THERE are two prime essentials in satisfactory and serviceable low cost construction—in addition to knowing how, good materials and good equipment—which are *drainage and uniformity*.

No matter what type of surface is to be laid, the roadbed should be drained carefully, so that water will not stand on the road surface or in the ditches alongside of the road. Keeping the water table well below the surface can be attained by adequate ditches and frequent culverts; or in very flat sections by constructing the road in fill from material taken from the ditches, and thus raising it

above the surrounding land level. In addition to the advantage in drainage, such construction reduces drifting of snow.

Uniformity is important because pot-holes and raveling are caused principally by lack of uniformity—poor distribution of the binding material, or coarse material in one place and fine material in another, with consequent varying penetration or tar or asphalt, or uneven wear and deterioration.

In the final analysis, it does but little good to build even 90% of a road surface properly, if the other 10% is improperly done.

From the point of view of cost, the utilization of low cost materials is also practically an essential in low-cost road work, if costs are to be kept down. Such use of locally produced stone, sand, slag or gravel affords added opportunities to local industry and for local employment.

Surface Treatments

"SURFACE Treatment" consists of the application of tars or asphalts to a suitable road or road base, and covering with a thin layer of sand, gravel, slag or broken stone, sufficient in amount to take up the binder material and form a protective covering for the road.

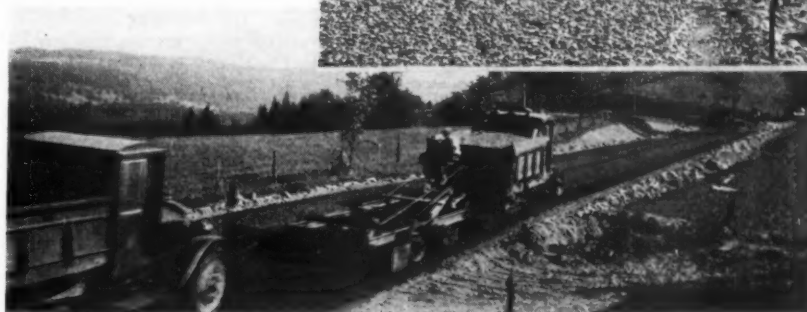
A requirement is that the road to be treated be sufficiently strong to carry the traffic loads to which it will be subjected. Surface treatment does not add strength; it merely reduces annual maintenance costs, while providing a smoother riding road. Old gravel or macadam roads are suitable for surface treatment.

Preparation of the Surface

BRINGING the roadway to a proper shape or contour, so as to insure a good riding road is always the first step. There are two general types of surfaces adaptable to such treatment: 1. Compacted surfaces such as will be found on previously treated roads such a gravel or macadam; 2. Loose or unbound surfaces,

(Right) Applying crushed gravel surface course for Mixed-in-place construction, Vermont.

(Below) Mixing with maintainer.



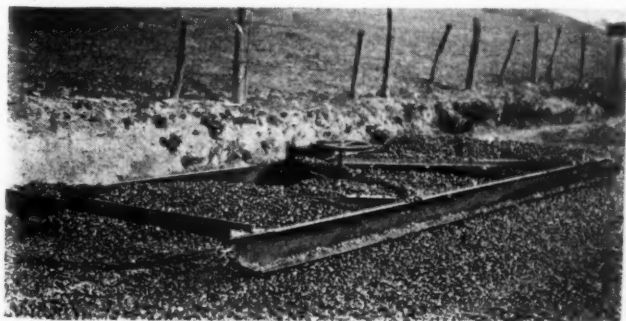
such as are found on roads with traffic bound surfaces. Those of the first type require only shaping and smoothing, and then brooming or sweeping to remove the dust and surface dirt. Those of the second type, if they cannot be swept fairly clean, should be given a priming coat of tar, asphalt or emulsion, lightly covered with aggregate, dragged and rolled to bind the material together. If necessary to eliminate major irregularities, they should be bladed or dragged.

Two Types of Treatment

THERE are two types of surface treatment, single and double. In the former, a small amount of binder of tar or asphalt is applied to the surface to be treated and this binder is covered with stone, gravel or slag, about half-inch in size. After these steps, the surface is dragged with a long, heavy drag, or broom-dragged and rolled. Such single treatments form not only a seal or protective

coating on the road, but may also provide a non-skid surface on previously "skiddy" and slippery roads.

The double treatment is used primarily where the surface is not thoroughly compacted, or where it is desired to build up a heavier course to carry a larger volume of traffic. The first application is a binder or priming coat of asphalt or tar. Following this, stone or gravel of small size is spread on the surface thinly, and this is dragged and rolled. The second application of asphalt or tar may be a little heavier than the first, covered likewise with about half-inch stone, after which the surface is again dragged and rolled. The result is a smooth all-weather road.



3

"Dragging the Surface is Meeting with Increased Favor . . ."

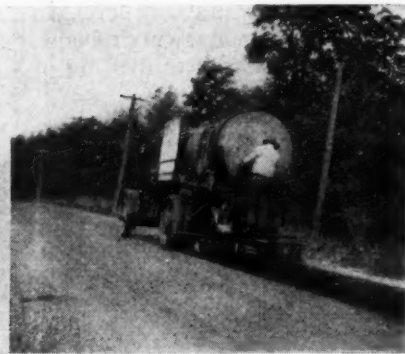
1. Long base drag.
2. Wooden drag.
3. Broom drag used to distribute chips over hot treatment.



Preparing the Surface



Sweeping



First Application



Distributing Cover



Rolling



A Finished Road

Six steps in Low Cost Road Construction

Equipment and Costs

THE equipment necessary for such surface treatment work comprises only a blade grader, a stone spreader, a drag, a roller and a pressure distributor for applying the tar or asphalt. The cost of such work is dependent very much on local conditions, costs of materials and labor costs; but in most localities, such surface treatments can be given to established roads for 4 to 20 cents a square yard.

Road Mix, Retread, or Mixed-in-Place

IN THIS type of construction, broken stone is ordinarily used for the aggregate, though many varieties of gravel have given excellent results if employed properly with the correct bituminous material. Either tar or asphalt may be used, the construction methods differing slightly in each case. Where the base or foundation of the road is substantial, such a surface will carry satisfactorily and economically in excess of 1500 vehicles per day without heavy maintenance charges. Construction can be carried on even in cold weather, if simple precautions are taken to protect the work.

This type of surface is of especial advantage where a road already ex-

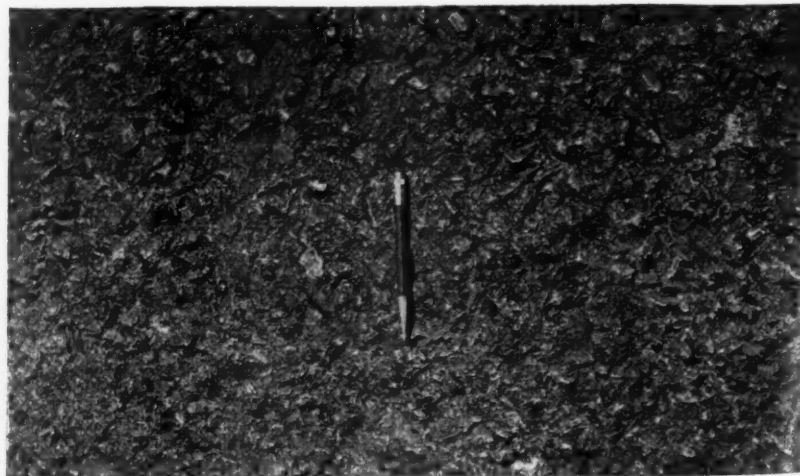
ists, which has been compacted through years of use, is well-drained and has fair alinement and grades, but which lacks surface smoothness or requires excessive maintenance. Old macadams, or well-compacted gravel surfaces are examples of roads which, at a comparatively small cost, can be turned into smooth-riding highways able to carry large volumes of traffic.

Materials and Costs

BROKEN stone is a desirable aggregate; tars or asphalts are the binding agents. The cost of construc-

tion varies with the aggregates and with the other costs, but should rarely exceed 40 or 50 cents per square yard of finished surface.

All the stone to be used is placed in windrows along the sides of the road or down the center. By means of a power grader, or a tractor-drawn blade grader, the stone is worked evenly and smoothly over the road surface; asphalt or tar is applied and the stone, thus coated with the bituminous material, is then turned back and forth several times so as to coat each particle thoroughly with the bitumen. This can be done with the grader,



The Non-Skid surface of the Road-Mix

or by means of a drag or harrow pulled by a tractor or by a heavy truck. The surface is then bladed so as to make it smooth, and then rolled.

During rolling, small stone chips are swept into the surface voids of the pavement so that these are uniformly and thoroughly filled. A "seal" coat of the bituminous material is then applied, covered with stone chips, swept and rolled.

Winter Work

THERE are no serious difficulties to the construction of such surfaces in the winter. The aggregate may be damp, but it should not be wet. The various processes of blading, applying the tar or asphalt, rolling and finishing should follow one another closely; and there is likely to be some lost time because of unfavorable weather conditions, but excellent results can be obtained with careful construction.

Full information and construction details for laying these types of surfaces can be obtained without cost by writing to the Editor of this magazine.

Resurfacing Old Pavements and Other Special Work

GENERALLY resurfacing work is done over surfaces that have become uneven and rough through long use. In such cases, the

depressions should be removed by scarifying or dragging, smoothing and then rolling. When a roller with a scarifier is available, this can do nearly all the work, except that a heavy drag or blade grader may be needed if the surface is unusually uneven. Preliminary patching may even be needed on the rougher surfaces, and in doing this it is desirable to use for the patching the same type of material that was used for original construction.

Reducing the crown on old surfaces may also be necessary, since many road crowns are too high. This operation can often be carried on at the same time as the general resurfacing work, or it can be made a part of the preliminary work of patching and smoothing.

In many cities there are abandoned street railway tracks which have never been taken up. These may be covered in connection with general street re-

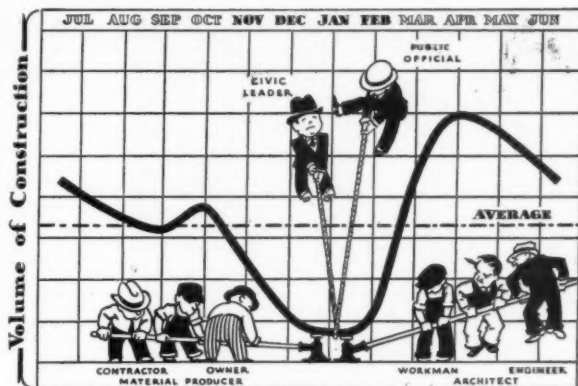
surfacing; the track area may be covered or surfaced with a thin layer to smooth it up, or only the rail grooves may be covered. Bituminous materials, properly selected and used will give a feather edge on such work, preventing rough places, and adhering to the steel.

Plant-Mix Surfaces

PLANT-MIX bituminous pavements differ from road mix in that the material is mixed in a bituminous paving mixer, or even in a concrete mixer, and hauled out to the road where it is dumped in a windrow, and spread by means of blade graders. The entire plant can be set up at a gravel pit or quarry, with a screening and crushing plant in combination, and thus produce paving material at a very low cost.

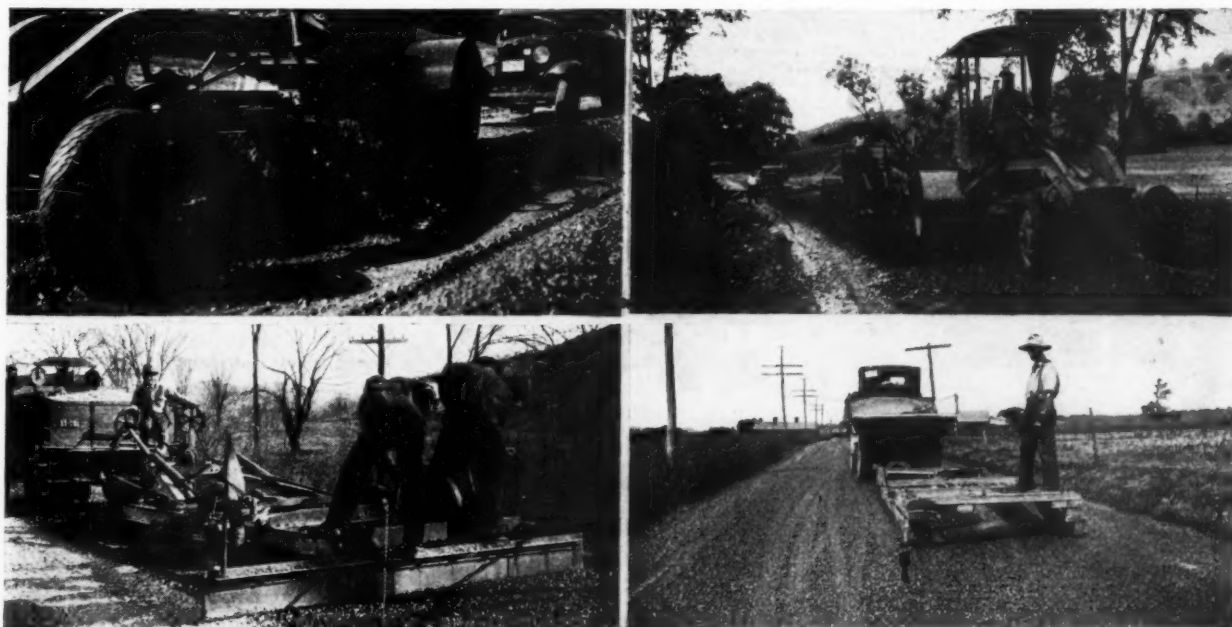
Plant mixes have also some technical advantages of allowing the use of heavier grades of tar and asphalt, and of permitting laying in weather that would stop work on a mixed-in-place job. Work can be carried on later in the fall, and can be begun more quickly after a rain. This permits a longer working season, and more employment for highway labor.

As in the case of other surfaces mentioned in this series, but little equipment is needed for construction. The mixer, the trucks to haul the mixed material to the road, one or more blade graders and one or more rollers are necessary.

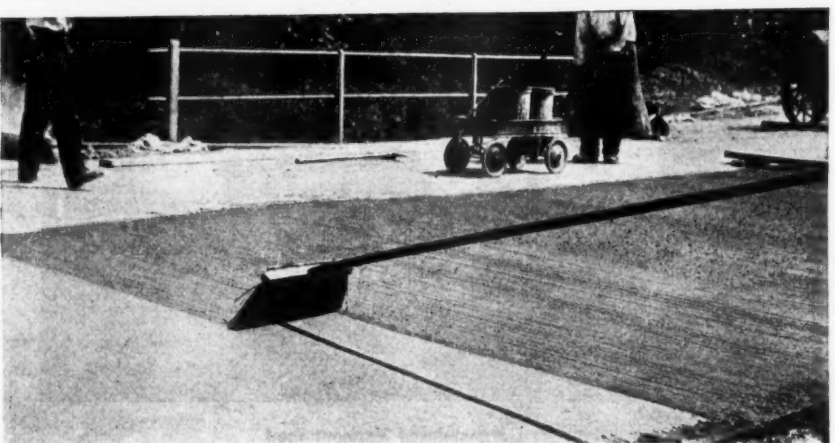
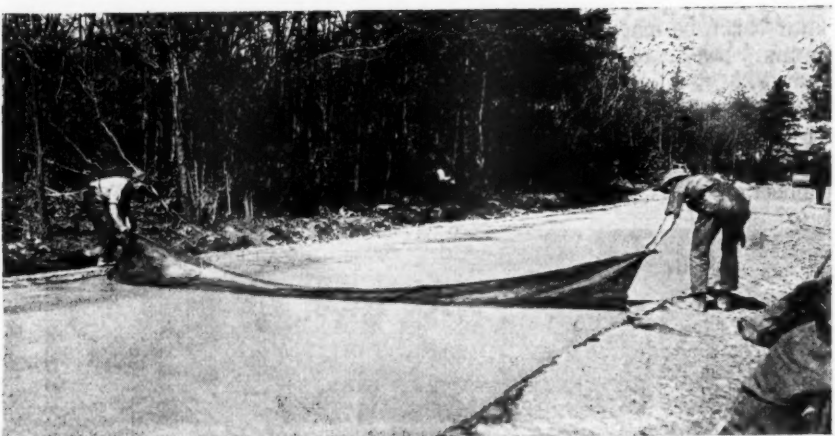
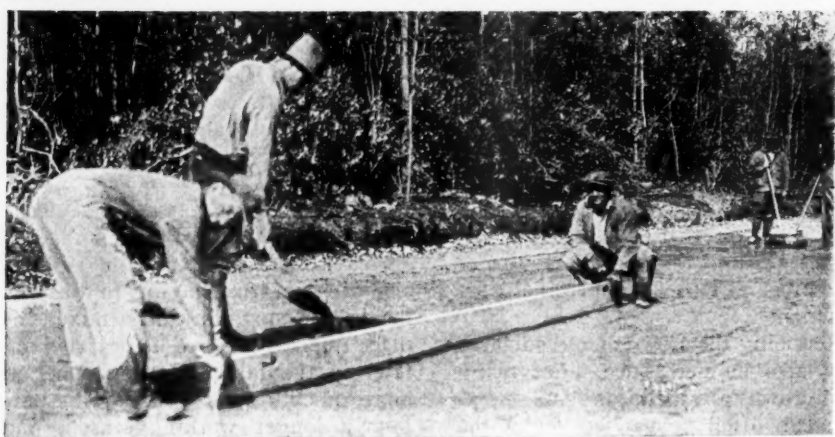


Courtesy Portland Cement Association

Winter Construction is needed



Steps in the construction of a rural low cost surface, and a completed Vermont road



Cement-Bound Macadam

THIS surface type, which is suited for all volumes of traffic, up to the heaviest, is simple in construction, employs equipment, most of which should normally be owned by every city, county, or state highway department, and utilizes sand, stone and gravel, which often can be obtained locally. The equipment needed includes small tools, spreader boxes, one or two tandem rollers, a mixer for the grout, and a scale for weighing the sand.

The roadbed should be graded carefully, so as to give uniform support to the road slab. If the subgrade is not very firm, a thin layer of stone, gravel or slag may be rolled into it. Coarse aggregate is spread by hand, or, preferably, with spreader boxes, and rolled with ordinary tandem rollers.

Sand and cement are mixed together in the mixer, and the grout distributed evenly from edge to edge of the slab, while men with push brooms direct the flow and work excess grout ahead. The surface should be rolled until a hard, compact and even surface is obtained.

Highway construction of this type is especially desirable for streets and highways carrying considerable volumes of traffic. The cost per mile is relatively low, depending to a large extent upon the cost of aggregates; construction can be by contract or by force account, as may be locally desirable. Equipment is not costly, and should be available in almost any locality.

Concrete, Brick, Asphalt and Other High-Type Pavements

FOR those highways carrying heavy traffic—the trunk highways—the strongest and most durable pavements are required. The construction of these contribute very materially to national recovery, providing labor for men directly on the job, and also just as directly for men employed in cement mills, railways, mines, steel mills, concrete mixer and other road equipment plants, and in innumerable other ways.

The traffic survey already mentioned will indicate where such roads are needed, if there is really any doubt about it. But there are still many thousands of miles of trunk

Steps in Laying Cement-Bound Macadam

highways on which adequate pavement has never been placed. There are, in addition, many thousands of miles of roads carrying large volumes of traffic which should be widened, so that this traffic may flow more safely and with less delay.

The design of such roads has been so well fixed through years of investigation and research that failures are practically non-existent, and an asphalt, brick or concrete road will serve for a generation or more under the heaviest traffic. Such roads reduce materially the cost of operation of buses, trucks and automobiles and in so doing justify their cost of construction, usually many times over.

Equipment for Highway Work

IN OUTLINING briefly, in the foregoing paragraphs some of the types of road surfacings which can be laid at low cost, with considerable employment of labor, types of equipment which are vitally needed have generally been mentioned; illustrations have been shown of such equipment from time to time. For thoroughly good construction, good equipment is needed. For instance, hand distribution of asphalt or tar cannot accomplish as uniform work as can a pressure distributor, with the result that in some places the mix will be too lean and in other places it will contain too much bitumen. Failure will result in either case.

Rolling of the finished surface is almost always necessary, and a modern roller is an economy. Besides producing better work, it will be faster, and cost less to operate. There need be no holding up of the work to wait for the roller, nor skimping of rolling to delay the progress.

Hand mixed concrete cannot compete in either quality or cost with the machine mixed product.

One grader may look like another; yet on the newer, heavier types of surface which have been described, as much as 2 or 3 inches of heavy stone

end in skimping on vital equipment. The costs of such equipment, after all, is only a fraction of the total cost of the road, the proper construction of which is the important thing. Moreover, national recovery cannot be attained by refraining from purchasing needed equipment and tools.

Construction

THE types of highways which have been briefly described in the preceding pages may be built by contract, that is, the work may be awarded to a contractor for construction, the cost being determined by competitive bidding; or it may be done by force account work, which means that the city, county, or state hires the necessary men,

furnishes the equipment and material and does the work, usually under the direct supervision and control of the city, county or state engineer.

Either way will ordinarily produce satisfactory highways. Which way will be cheaper depends upon the size of the job, the character of the work, and upon the restrictions which may be placed upon the methods and hours of labor and the use of machinery.

The larger construction jobs should ordinarily be carried on by contract, for in this way economy and good construction are generally secured. The smaller jobs, such as resurfacing short stretches, widening bridges, and numerous of the other projects mentioned in this series can best be done by force account, under the direction of the engineer.



Top of page: A modern grader on maintenance.

Center: The roller is essential equipment.

Left: The bituminous distributor.





Draining Road-Bed With Perforated Pipe. Good Drainage Is a Pre-requisite.

Highway Safety

AS MANY American citizens are being killed in automobile accidents annually as lost their lives in the World War. While many of these fatalities are due to "human failures" and are not the fault of our highway systems, yet any improvements that will materially reduce this death toll are worthwhile. Several types of improvements are especially fitted for unemployment relief work, and as such should be pushed so as to eliminate "allies of accidents" so far as possible.

"Death hazard" curves can be rounded out, sight distance improved, proper guards erected on the outside of the curve, and the highway properly marked, both with warning signs and with center-line or other stripes.

"Narrow bridges" can be widened, with the employment of labor, and despite cold weather conditions. There

is nothing more conducive to accidents than a dangerously narrow bridge, with the consequent confusion and fear in drivers' minds, sudden slow-ups, shifts, and opportunity for errors in judgment.

Narrow roads, relics of the past, cause many accidents. They are easily and cheaply widened with concrete or with bituminous surfaces laid alongside the present surfaces. Or perhaps a steep hillside makes widening difficult.

Dusty roads were once a source of serious danger on our main highways. Today that danger is just as serious from the cloud of dust raised by a passing car, cloaking all other vehicles, and blinding the drivers.

Grade crossing elimination affords plenty of work to skilled and unskilled labor, alike, utilizes equipment, employs materials—and save lives. The cost is often heavy, but the costliest ones are those that are not yet built.

Retaining Wall Construction

THERE are many places along highways where retaining walls are desirable. In cuts a low wall may greatly reduce maintenance costs, by preventing mud and stones from sliding into the road or filling the gutter, requiring frequent maintenance work. In road widening, retaining walls may be built either against the bank, thus affording a wider roadway than would be permitted by the safe slope of the cut; or may be employed to build up a support on the lower side of the road, in this way permitting a wider right-of-way.

Relaying Old Brick Pavements

BRICK pavements, 20, 30 or more years old, exist in many of our smaller communities. These have served well in bearing traffic over a long period of time, but they may no longer be smooth enough to meet the demands of present-day traffic. Such pavements may be taken up, the brick cleaned and salvaged, and laid on a new bed with the unworn side up. This results in practically a new pavement at a very low cost, and affords employment to a considerable force of men. New methods of laying, and means of attaining new standards of smoothness are available to engineers of today. But little material is required aside from that usually produced locally, though some new brick will be necessary to replace those worn or lost in cleaning or removal. These repaving projects are of especial value in small communities, and are also desirable on many state highways which no longer provide the smooth-



The First Step in Rural Road Construction.

riding surface demanded today by the traveling public.

School Paths

IN MANY of the more thickly settled communities, pedestrians are forced to walk along the edge of heavily traveled highways. This creates a special danger to school children because they frequently walk in groups, thus occupying a considerable portion of one traffic lane of the highway, they are apt to play or run about without paying any especial attention to traffic dangers, and there are always smaller children who may not realize the danger.

A program for the construction of such paths was started as far back as 1931, as an unemployment relief measure in Multnomah Co., Oregon. The men employed varied from 600 to 1800. The men were organized into groups of 8 men, with a foreman, and two 1½-ton trucks.

The walks were generally made four feet wide, except in a few places where, because of very heavy cuts or fills this would have been costly or impracticable.

There are few places where such construction is impractical. Retaining walls can be constructed cheaply in many cases, either of local stone, concrete, a combination of the two, or of crib-work. The greatest difficulty is likely to arise where private property has been improved up to the pavement line, but a careful preliminary reconnaissance and frank consultation with these property owners will usually result in an amicable agreement for carrying on this work, so important from the safety factor.

In the work in Multnomah County, the cost of such footpaths was less than 10 cents a foot.

Making a Bridge Survey

STATE and county highway departments often lack essential data on the bridges under their control. This is also frequently the case with cities, and almost universally with townships, which, in the aggregate, control more miles of highways than any other group of governmental units.

The collection and recording of pertinent data will afford employment to a large group of engineers; will disclose the need for repairs that may postpone replacement; will bring to light the possibilities of necessary or desirable construction projects which will improve the highways and make them safer for traffic; and will provide



Concrete Is a Basic Construction Material—Use It.

data of real value in planning the highway work of the future.

Data to Be Collected

THE type, span and width of the bridge; the materials, size, spacing and condition of the truss members or of the stringers; the condition of the floor and the materials of which it is composed; the condition and materials of construction of the abutments; the width of the roadway which it serves; an estimate of the amount of traffic which uses it, and of its weight; the kind, condition and safety of the approaches and of the guard rails. All these factors should

be noted and recorded, along with information regarding the need for repairs, painting, reflooring, etc. A photograph of the bridge should also be taken.

Types of Projects Which May Result

RECONSTRUCTION of wing walls or abutments to prevent damage to the bridge or to the highway during high water periods offers an opportunity for worthwhile employment of labor, while carrying on work that may save much larger expenditures in the future.

Widening of bridges is discussed

briefly elsewhere; widening of bridge approaches by means of filling operations, or straightening them, may add greatly to the safety and comfort of the road. Proper guard rails on the approaches and on the bridge are a most important safety feature, and one that should receive far more attention than it does now.

Painting and Reflooring Bridges

MANY bridges need to have the iron work—trusses, guard rails, floor members, etc., cleaned and painted, and this is most desirable work since it may greatly prolong the useful life of the bridge.

Wooden floors need frequent replacement and even then do not provide very satisfactory surfaces. Such floors may be covered with thin bituminous planks or surfacings or steel non-skid floor plates may be placed on them. Concrete or brick make very useful surfaces, but are comparatively heavy—sometimes adding too much to the load on the bridge.

Direction for making a bridge survey, data covering cold weather construction of wing walls or abutments, and information on cleaning, painting and reflooring will be sent free on request to the Editor.

Widening Culverts and Small Bridges

MANY of our roads are decorated with signs "SLOW—NARROW BRIDGE."

These narrow bridges constitute a very definite and serious danger to traffic, as is evidenced by the battered condition of the approaches and end walls on many of them.

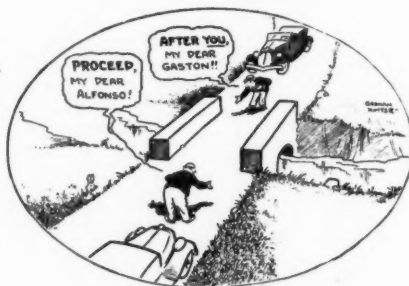
Such bridges and culverts are relics of bygone days when travel speeds were slow and few cars used the roads. Fortunately, most such hazardous structures can be widened and made



One Way of Widening Culverts.

safe at a low cost, while providing employment for a considerable number of men, and such work will greatly increase the capacity of the highway and the pleasure of using it.

Culverts can be widened perhaps most readily by the employment of



corrugated metal pipes made especially for this work. These are available in sizes up to about 120 inches or 10 feet in diameter. A particular advantage of metal pipe is the fact that work can be carried on practically without regard to weather conditions.

The pipe can be threaded into the culvert, or if the culvert is failing, it can be completely lined. By extending the culvert, the road can be widened as shown in the accompanying illustrations.

Concrete can also be used for extending such culverts or smaller bridges. When the work is to be done in the winter some precautions must be taken to prevent damage to the concrete. At practically the same cost, a quick-setting cement can be used. This generates some heat in the setting process, requires a shorter period of protection, and generally is of great value in winter work. Ordinary Portland cement with an admixture of calcium chloride is also more resistant to freezing and sets up more quickly.

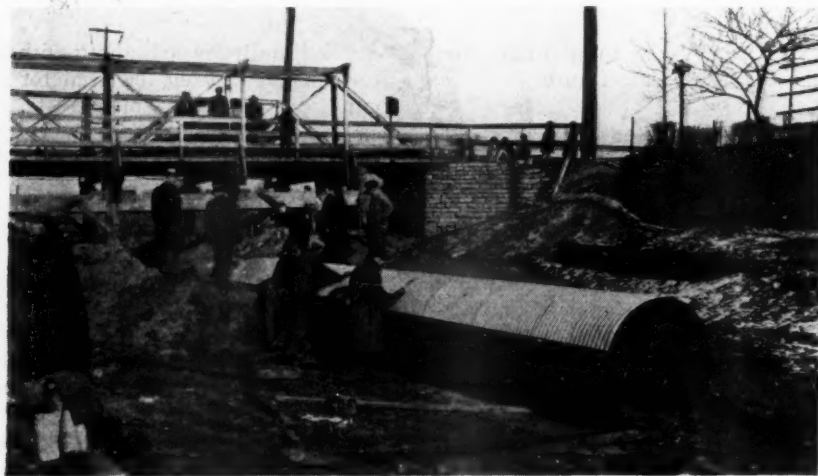
In more thickly settled areas, the culverts and small bridges can be widened enough not only to take care of vehicular traffic, but also to provide footpaths for pedestrians. This work, therefore, can perform a double measure of safety.

The advantages of such work, which can be done even in severe weather, in addition to making the highways safer and more travelable, include an opportunity for the employment of a considerable force of men.

Widening Highway Fills

MANY highway fills are so little wider than the traveled way constructed on them, that they are a psychological hazard to a large proportion of highway users. As a matter of fact, when such fills are protected only by the outmoded and unsafe wooden guard rail so often used on them, they constitute an actual, as well as a psychological, hazard.

Widening such fills is possible with-



Winter Employment Preparatory to Filling an Old Canal.



Suggestions for Road Grading.

out increasing the base width through the employment of retaining walls, which are mentioned elsewhere in this series of articles; but this is not often necessary, and the simplest way is likely to consist of adding dirt or rock in sufficient amount materially to widen the top, and perhaps also to decrease the steepness of the side slopes. This work can be done very well in cold weather, provided the material is excavated from a deep narrow pit or taken from a quarry. Shallow earth excavation is difficult in cold weather, but rock excavation, can be done quite efficiently.

Fills usually are in low areas, requiring a culvert or pipe under them for drainage from the upper to the lower side of the fill.

supplemented by low grades and smooth road surfaces, is not sufficient. A general love for natural beauty demands also an attractive roadside.

Aside from covering over the scars of construction and carrying out a general program for natural beautification, a chief aim is prevention of erosion. The work in general consists of the selecting and

Road Improvements

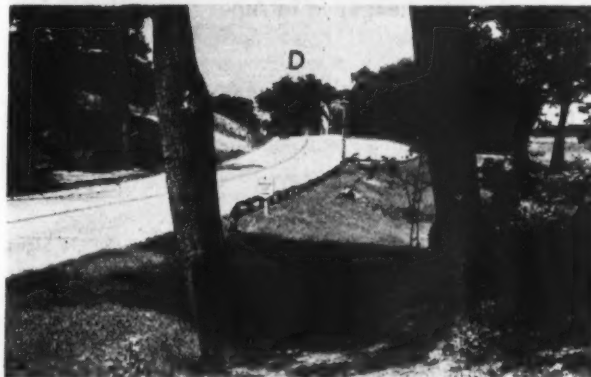
HIGHWAY traffic is to a considerable extent recreational. Those who drive most often select attractive routes, even though on a business trip, and frequently even though the distance traveled be longer. The routes of greatest beauty will be traveled most in the future as in the past. The traveler's money, spent for gasoline, meals, lodging, garage services and incidental expenditures, makes it worth while to please them. It is estimated that highway tourists spent \$274,000,000 in Michigan in one year. Mere road mileage, even when

cutting or pruning of existing growth, the removal of stumps, and dead material, the obliteration of borrow pits, the flattening of slopes (which reduces the road hazard), the rounding of slope intersections, the seeding or sodding of shoulders and slopes, and the planting of suitable material to accomplish a reasonably comprehensive improvement.

The projects should contemplate complete development ultimately, but immediate work can be limited, according to the season and the funds available, to grading, removal of stumps and dead material, advance preparation of the soil, and seeding, in season. Wild or native trees and shrubs can be planted.

This work requires the services of an experienced landscape architect, whose assistants may be engineers or landscape architects.

On the average job of this type,



Above: Fitting the highway to its natural surroundings. Turn-out shown in lower picture.

Left: A landscape planting crew preparing newly graded area for final planting by adding top soil and humus.



Farmers' teams find work to do on roadside improvement.





Signs at a State Highway Intersection.



Beautiful Trees Should Be Preserved.

40 to 50 men can be employed for 6 to 8 weeks or more, depending upon the size of the job; in addition, trucks, teams, their drivers, and a reasonable amount of equipment are needed.

Properly directed, this work is exceedingly desirable for the employment of labor. Three articles recently published by PUBLIC WORKS cover this field of work excellently. While copies are available, they will be sent free on request to legislators. Circular 191, for sale by the Supt. of Documents, Washington, D. C., price 5 cents, devotes 35 very interesting pages to the subject.

A well balanced program of roadside improvement utilizes local labor to a maximum degree. More than 90% of every dollar spent for this type of constructive work ultimately arrives in the pay envelope of labor. Of this, 65% to 70% is a direct benefit to local labor and 25% to 30% is a benefit to other labor engaged in supplying plants, incidental labor and equipment. Moreover, such work can be carried on throughout most seasons and weather conditions.

Thus roadside improvement has an economic as well as an aesthetic value; provides work both directly and indirectly; and creates tangible assets of a reasonably durable nature.



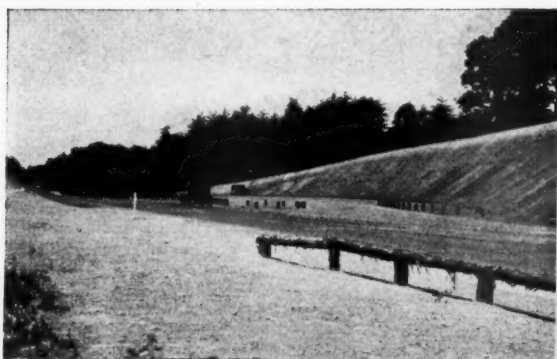
Safety Signs for Guiding Traffic

Street and Highway Marking

STREET signs are lacking on a great majority of the street corners of nearly every American municipality. This may be unobjectionable to local residents who are familiar with street names, but it is decided objection to visitors or strangers, the cause of misdirected and undelivered mail and packages, and a general source of confusion even to many citizens of the city.

Street signs can be erected in winter. Their preparation and the actual work of placing them—whether on posts or on existing light or other poles—is a desirable project that can be put into force at any time.

Highway signs are of two general types—directional and route number. To persons familiar with the roads, the necessity of frequent route number signs may not be obvious. On a strange highway, especially at night, such signs are of tremendous advantages. Directional signs are also extremely important to travelers. They should be placed at all cross-roads or junctions of any importance and at special points elsewhere. This work, which can be done even in cold weather, is greatly appreciated by the traveling public.



An ugly borrow pit transformed into a useful, well-graded turn-out.



This turn-out takes advantage of a natural widening in the topography.

Highway Turnouts

HIGHWAY turnouts have been suggested by Charles E. Grubb, former state highway engineer of Delaware, and now of the American Road Builders Association. He suggests that where it is impossible to widen a 2-lane road because of the cost—even though at times it is crowded to more than capacity—sidings or turnouts be constructed which will allow faster vehicles to pass the slower moving ones.

These turnouts or sidings could be located at such places as to keep the cost of construction at a minimum, that is, where it would be comparatively cheap and easy to do the work. Along almost every highway are frequent stretches where but little grading would be necessary to widen to 3 or 4 lanes the traveled surface of the road. Also they might generally be located so that when a third lane were added, these strips could be utilized.

Inasmuch as these turnouts would be utilized only when the load on the highway was very heavy, that is, one or two days a week, and then only for a few hours and for a portion of the traffic, a lighter and cheaper pavement material might be used, or the principles of "stage" construction adopted. This would make the initial cost very low and allow the surface to be improved as desired and as needed.

Such projects would afford work for as many men as it were desired to employ, would increase the traffic capacity of the main roads, and would greatly promote safety.

Marking Rights-of-Way

LIMITS of highway rights-of-way should be clearly marked. These markers, by indicating the exact limits of publicly owned property, may prevent misunderstandings and arguments with abutting property owners. In the case of relocation or maintenance work, such as sloping down banks, making fills, constructing retaining walls, etc., their presence emphasizes the ownership of the prop-

erty and indicates the limits to which work may be done. Every highway of importance—certainly all state and county highways—should be marked.

Such markers may be posts, 6 or 8 inches square, and 24 to 36 inches long. Wooden posts may be used, but concrete ones are much more desirable and economical. These may be set to project above the ground 6 to 8 inches.

Generally the posts must be located by an engineering survey. The records of dedication of the highway must first be studied and the property bounds noted. These can then be run out in the field by a small survey party and stakes driven to locate the markers. These should be placed at all points where the property line changes direction, and also at distances of 440 feet, more or less, on straight lines. The gang installing the markers should reference them in carefully by distance and direction measurements to trees, rocks, bridges, culverts and other nearby permanent objects.

The concrete markers can best be precast, and this can be done under cover, even in winter or in inclement weather.

A project of this type is especially suitable for employment work. The job of securing the data on the bounds from the public records is a good type of work for workers of the clerical type, and can be done without regard to season or weather. One or more engineers may be assigned to assist in this work. Other engineers will be needed, with 2 or 3 helpers each, in locating the right-of-way lines in the

field and placing the marking stakes, and this can be done except in the most severe or disagreeable weather.

Clearing Rights-of-Way

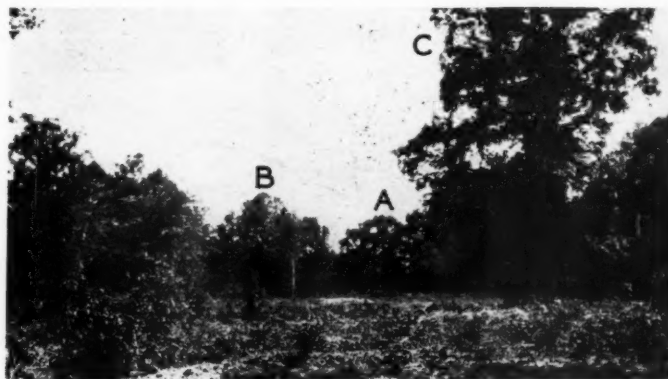
HIGHWAY rights-of-way need clearing, with brush, tall weeds, etc. cut back from the roadside and such trees removed as present a hazard to traffic. The weeds and brush along the road may present a fire hazard from cigarettes or matches tossed from passing vehicles, and such fires may spread to adjacent woods or grain fields.

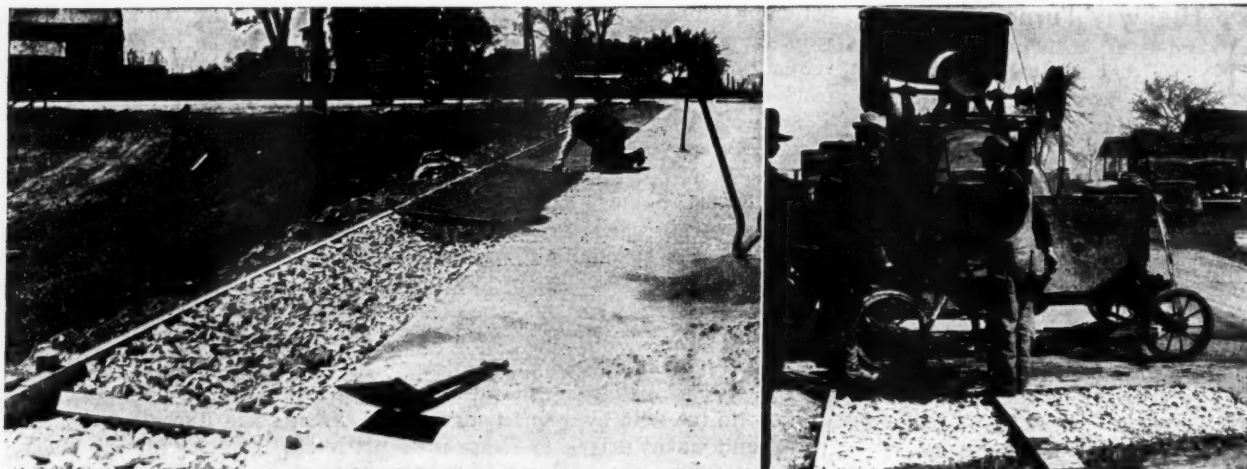
Weeds are difficult to control, yet it is important to prevent them from coming to maturity lest the seeds spread to grain fields, meadows, or gardens along the road. These can be cut very economically by means of some of the mowing machines designed for such work, employing farm teams and farmers for the work. Or the weeds can be killed by means of chemicals or oil. Several articles on the control of weeds have appeared in *PUBLIC WORKS* during the past few years.

Weeds and brush contribute to the snow problem by causing snow to drift into the road. The principle of the snow fence is that it causes the drift to form off the road surface. With brush and high weeds near the highway, the snow fence may not be fully effective.

In removing trees or brush that may grow into trees, great care should be taken not to destroy growths that may be of use in planning and effecting roadside improvements.

Clearing for highway location. When properly done, results in beautiful roadsides, as shown at the right.





Widening and adding gutters and ditch linings is useful work which provides employment.

Guard Rails

GUARD rails are mentioned also under "safety" and properly so, for good guard rails are a powerful factor, both mental and physical, in the prevention of accidents. They should be plainly visible; and when so, they show the driver where the edge of the road lies and allow him to concentrate his attention on other driving hazards. They are also used to attract attention to such hazards as narrow bridges or culverts, curves, etc.

Wooden guard rails are likely to make an accident even worse, through

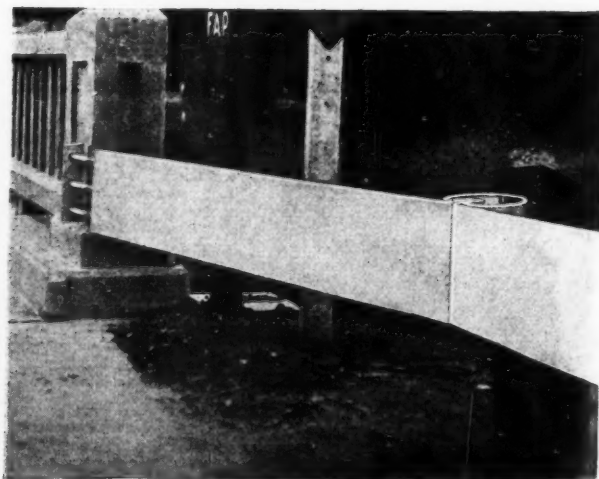
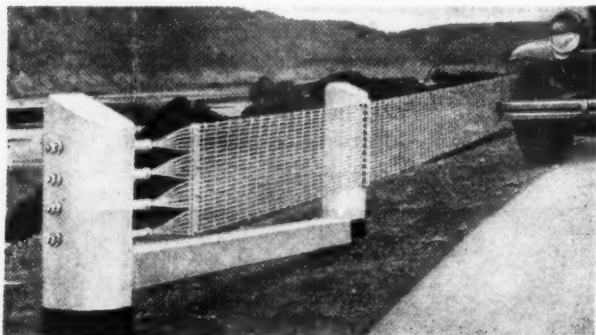
the breaking or splintering of the planks. Other types, of spring steel, steel tape, woven wire, or cable are far more efficient and incomparably safer. Wooden rails should be replaced, and doing this would give employment to many thousands of men, while promoting highway safety.

Improving Roadside Gutters

THE careful grading given to gutters by maintenance or construction forces is destroyed by the first heavy rain. In comparatively level areas, gutters then become choked and hold water, which not only

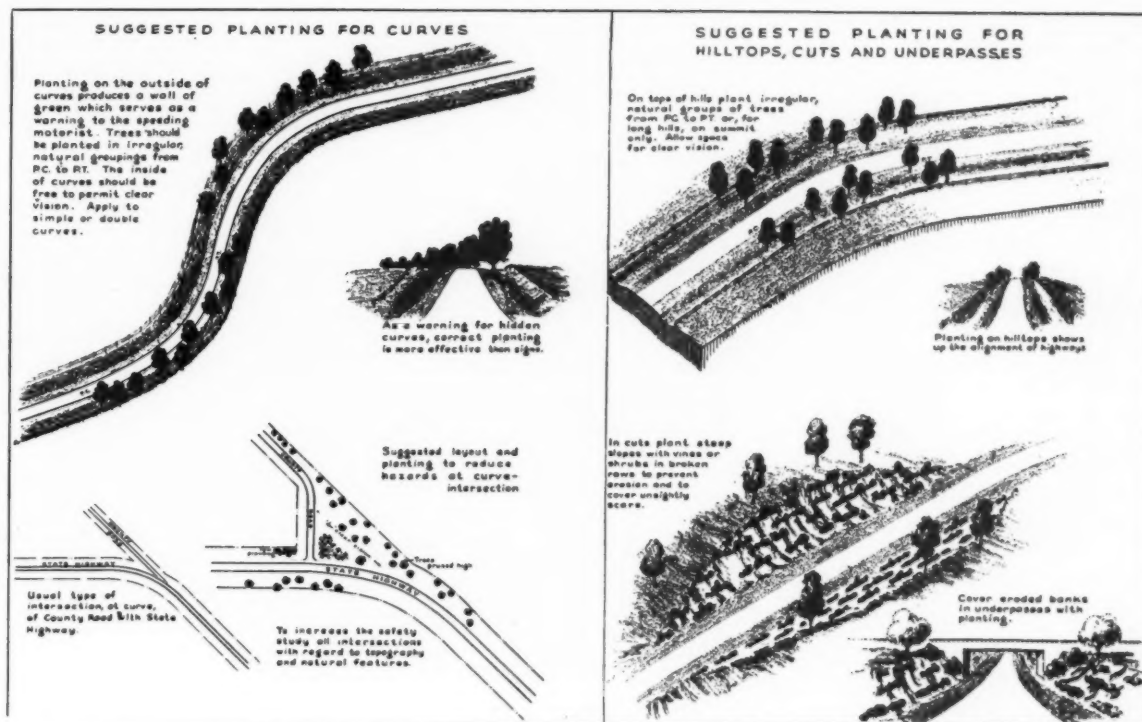
soaks into the soil supporting the road, but also, in warmer weather, produces numerous mosquitoes. On hill-sides, unprotected earth gutters wash badly. It is often a paying proposition, purely from the viewpoint of reduction in maintenance costs, to pave gutters.

Such work, which will provide for the employment of any desirable number of men, may consist of special concrete lining, or may be constructed of local stone. The former is often desirable in that a more uniform flow is possible and the smoothness of the gutter allows it to carry much more water.



Modern and safe types of guard rail.

Plantings for curves, hill tops, cuts and underpasses, as used in Texas.



Planting Along Highways

PLANTING of trees, shrubs, flowers, etc., should generally be done only in accordance with a well defined and carefully made plan, such as is mentioned generally under the heading of *Roadside Improvement*. However, maintenance forces can do considerable excellent work by judicious selection and planting of wild growth from the roadside.

In northern states, such plantings have been used effectively for snow fences. In such places, they should be planted well back from the roadside. Unless the right-of-way is fairly wide, there will not be room for such plantings if they are not placed on private property. Wide rights-of-way are desirable.

The planting of such natural fences when coupled with intelligent planting and other roadside improvement work, furnishes a very desirable means of utilizing certain types of labor, especially rural labor. The work can be planned seasonably so as to take

up slacks in other work, and can be carried on in almost any weather except the most severe. Moreover, unskilled help can do the major part of the work.

Storm Drains

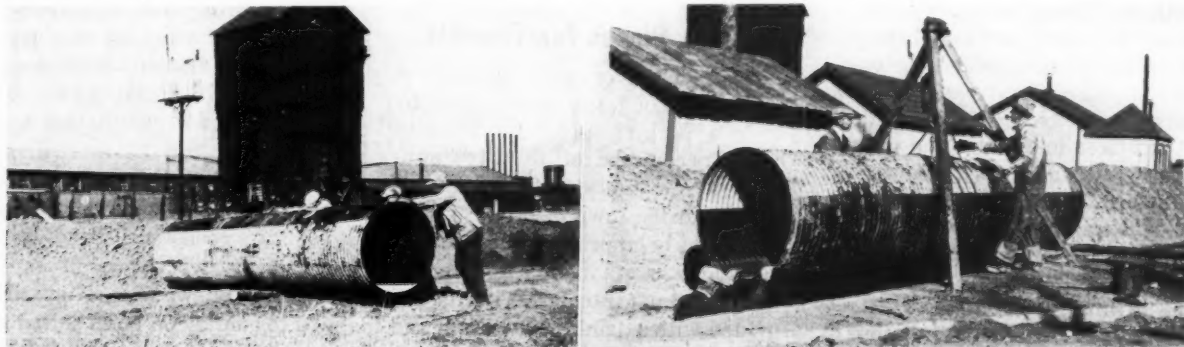
STORM waters for which adequate provision is not made, cause much damage to streets and highways. No city should plan the paving or improvement of a street without providing an adequate storm drain system to carry off the heavier rainfalls without damage to the streets or to private property, and without undue inconvenience to pedestrians.

Computing the amount of runoff that may be expected from the heavier rainfalls is rather a complicated engineering procedure. Several articles on the subject have appeared recently in *PUBLIC WORKS*, and the editors will be glad to be called on for advice and assistance in this work. Generally provisions must be made for about one

cubic foot of storm water per second per acre drained.

Large pipes are therefore required. These may be of corrugated iron, vitrified tile, cast iron, or reinforced concrete. The latter can be purchased or made locally. When the latter plan is followed, a sound project for unemployment relief is available. Forms can be purchased and the pipe made during the winter or in inclement weather. Concrete pipe, thus made, is heavy and some method of handling it is necessary in the larger sizes. A small gasoline crane is excellent for this and is very useful to any city.

Like sewers, storm drains must flow by gravity and not under pressure. Therefore considerable excavation may be needed for these large pipes. This work should be done in advance of the paving. In fact, such work is often a very suitable cold weather construction project, especially in the areas where winter conditions are not too severe.



Types of Piping Adapted for Storm Drainage Work.

Manholes, inlets and catch-basins are part of a storm drain system. The castings necessary can be made locally, if there is a foundry available, or purchased cheaply from manufacturers.

Making Roads Safe in Icy Weather

WHEN snow or rain freezes on a road surface, driving is dangerous, especially so on hills. Many states and counties, as well as the larger cities, place piles of sand or cinders along the highways or streets, at such points, for spreading by the maintenance forces when ice forms. It has been found very desirable to treat such sand or cinders with a calcium chloride solution. This not only prevents the piles from freezing but adds greatly to the effectiveness of the material as a skid preventive.

Where such work has been carried on previously, the locations of the sand and cinder piles have been selected, and the only work necessary is the procuring of the material, mixing it with the calcium chloride, hauling and placing.

Where such accident-prevention work has not previously been done, it is a worthwhile project to begin it. A survey party or parties can drive over the road system, locate the points where such work is desirable or necessary, and estimate the amount of material needed. Another party may be sent out to locate sources of supply and to arrange for screening and mixing with calcium chloride, and determine the length of haul necessary.

Improving Streets with Brick Gutters and Parking Strips

BRICK gutters maintain a true and even flow line, give a surface which will not deform under the weight of heavy traffic, either parked or in motion, and also provide a surface that is resistant to the chemical action of gutter fluids; and in the northern cities, where gutters may be filled with ice during winter months, a material not subject to injury through ordinary snow or ice removal methods.

Gutters of this type may be made from 2 to 7 feet in width. The most desirable width depends somewhat upon local practices in regard to park, and to local paving conditions. There appears to be a trend toward wider types of gutters, since these possess some advantages. The 7-foot strip is needed if it is desired that all four wheels of a car parked parallel to the



An Improved Gutter Made With Brick.

curb shall be on the parking strip, where as if it is planned only to provide a smoother gutter, a better pavement construction, and to catch oil drippings from cars parked diagonally, a 2 or 3-foot strip is wide enough.

Widths of gutters used in several cities are reported as follows: Columbus, O., usually 24 inches; Pittsburgh, Pa., 15 inches to 4 feet, depending on the width of the roadway; Detroit, Mich., 4 feet; Washington, D. C., 13½ inches, with a transverse slope of 1¼ inches; Atlantic City, N. J., 31 inches; Charlotte, N. C., 18 inches to 24 inches. Probably 1 foot to 2 feet is the usual width of gutters, the wider strips being provided for parking.

Parking Places for Tourists

NEARLY every community, small or large, would profit by a parking place for tourists, where cars could be left for a few minutes or a few hours, with the owners free to visit the town or city. Such an area should be appropriately surfaced and graded, so that mud or slippery roads would not interfere with its use, provided with a drinking fountain and toilet facilities, at least, and with such

other conveniences as might be desirable from local conditions. Such a parking place, attractively designed, would afford a real convenience to motorists and should also improve materially the income to the local community from the tourist trade. It is proper that through routes do not pass through main streets or civic centers; such a municipal parking place should afford an opportunity for those wishing to stop to do so, in comfort and safety, and free from the difficulty of finding a place to park on the streets, or from the usual parking restrictions.

Surveys of Local Highway Construction Materials

ECONOMY in highway construction can often be attained by the maximum use of local materials. However, unless the materials are suitable, inferior construction may result. A project which will often produce rich returns for the future is a survey of such materials, thus locating within the limits of a county or in the vicinity of a city, sources of stone, gravel, clay, sand and other materials. After these sources of materials are located, the materials in them subjected to analysis for fitness for highway use, and their capacity determined, it is possible that future highway construction programs may be so planned as to make maximum use of these materials at a considerable saving in cost.

For instance, if stabilized roads are to form a part of the system, the necessary gravel and clay are usually available. Such materials make good roads, when properly graded and mixed; unfortunately nature does not often grade and proportion these ingredients properly, and poor roads result.

Crushed stone and screened or crushed gravel can often be obtained from local quarries or pits, and a permanent, but money-saving, project can be created through the erection of a crushing and screening plant. Such a plant will give employment to a number of men and may also reduce considerably the costs of road or street construction and maintenance.

A survey can be carried on with any desirable number of men. It will furnish employment to engineers, geologists, construction foremen and men with experience in sand and gravel work, which groups are often hard to employ on tasks suited to their experience and training.



A HIGHWAY CONSERVATION CORPS

A Suggestion for More Employment and for Better Rural Roads

OUR highways and streets—state, county, city and town—aggregate in value more than ten billions of dollars. For the fuller conservation of this investment, for more employment, and better rural roads, we suggest a Highway Conservation Corps.

The Civilian Conservation Corps has earned a place in the esteem and regard of the nation. It has conserved our natural resources, furnished employment to more than 300,000 otherwise without work, and has been a powerful factor in the useful training of these men and boys.

A Highway Conservation Corps has the same opportunities for employment; the immediate good resulting from the work should be of even greater value because it will conserve and add to the value of our highway investment; and it will also train many thousands of young men in highway construction—one of the most important and necessary industries of the times.

The work of the HCC might well be concentrated on the improvement of rural roads through grading, widening and draining; by the construction of guard rails where needed; and by maintenance of existing rural roads. Construction of highway projects should not be a function of the HCC, but should be done by contract, as hitherto. The mission of the HCC should be to develop present unimproved roads to serve primarily rural areas.

The equipment for each group of 40 to 100 men might consist of a small concrete mixer, a light tractor, a blade grader and a scraper; a roller would prove desirable on many projects. If such work were carried on only during the spring, summer and early fall months, the housing problem would be small. In rural areas, workers could, in most cases, return to their homes for the night; elsewhere, tenting would be sufficient. An engineer or well-trained foreman, working under the direction of the state, city or county, would provide the di-

rection. Finances might be provided from present highway funds which are now being diverted to other and unrelated purposes.

The major problem would be to reconcile the conflicting requirements of relief and efficient construction. This might be accomplished through enrollment of those without work and desiring employment in the HCC in a Highway Reserve. In enrolling in this Highway Reserve, a record would be made of past experience and of education in highway work, so that engineers and foremen, truck drivers, tractor operators, concrete workers, and other skilled workmen could be selected as needed and placed on work of a suitable nature. Compensation could thus be set up with due regard to the character of the work and the relief of the unemployed.

Such a registered reserve would provide a reservoir from which contractors could draw local men—technical, skilled or unskilled, as needed—for construction work, and thus furnish employment to local men. Such enrollment could probably be accomplished through present local Relief Administration offices.

Of the more than 2½ million miles of roads in the nation, some half a million miles now unimproved are of sufficient importance to justify some degree of improvement. Placing at work on these roads a force comparable to the CCC would sift down still further the number of employable unemployed, would create work in factories and mills, and would open up rural areas to markets.

This plan, suggested by Mr. J. E. Pennybacker, has been discussed with highway engineers and with men who have had charge of CCC camps; both groups are enthusiastic. Most enthusiastic of all are those men who have had highway engineering experience and have since served on CCC work.

Write the Editor of PUBLIC WORKS your suggestions and comments.

Cement-Bound Macadam for Shoulder Work in New York

THE Cherry Valley Turnpike, a new concrete highway 20 feet wide across Onondaga County on U. S. Route 20, has many steep grades, in a number of cases as high as 10% and some nearly a mile in length. To keep down the cost of maintenance and prevent washing of shoulders and undermining pavement, concrete gutters are built in all the cuts at the gutter line. Water accumulation on these slopes after rains has caused excessive shoulder wash between the slab and the concrete gutters.

To keep down the cost of maintenance, various types of shoulders have been contemplated. Cold mixes have been used in order to produce a shoulder with the weight, density and depth needed to prevent wash. On this job the State Highway Department decided to build an experimental shoulder of cement-bound macadam on a 10% slope for a distance of 2,100 feet.

Construction

A power grader was used to scarify the shoulder for a depth of about 4 inches between the slab and the gutter. After scarifying, the dirt was windrowed, then loaded into trucks by hand. The loose dirt was all removed but no effort was made to fill low places since it was impossible to roll the subgrade.

The coarse aggregate, No. 3 stone, was hauled 18 miles from the General Crushed Stone Company at Jamesville and deposited on the edge of the pavement. The stone was then moved onto the shoulder with a power grader, leveled to a depth of 5 inches and compacted with a 5-ton roller.

A one-bag mixer was used for mixing grout in the proportions of 1:2½, with about 7½ gallons of water per sack of cement. This gave the mixer a working capacity of a ½ bag mix. After one minute mixing, the grout was wheeled to the shoulders in barrows and distributed over the surface with push brooms.

Immediately after grouting, the surface was rolled with the 5-ton roller. The best results were obtained by rolling transversely with the front wheels. After initial rolling, surface voids were filled with additional grout and the grouted shoulder then given a final rolling.

Final surface finish was obtained by using hand floats followed with a wet burlap drag. The edge next to the slab was then finished with an edger.

Curing consisted of 48 hours of wet burlap. The shoulders were opened to traffic in 5 days.

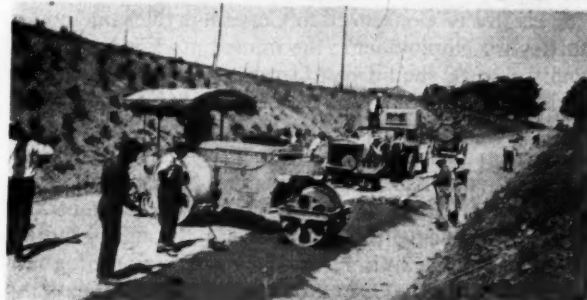
Cores from the completed shoulder averaged 5 inches thick, tested 2,325 pounds in compression at 28 days, with an absorption of 5.4%.

The finished shoulder blends nicely with the concrete slab and gutter and presents a very pleasing appearance down through the cut. The resulting shoulder will not wash even with the longest, heaviest rains and in addition, the shoulders are strong enough for the use of traffic and thus give a 3-lane emergency pavement in the hills, which is very advantageous.

During the construction of this first cement-bound macadam shoulder, it was possible to introduce several simplifications with construction procedure that reduced costs, and experience showed the way to further improvements that can be made that will reduce costs still more. Perhaps the most important finding was the

need of using a larger mixer, since the crew employed in grouting could handle additional material efficiently. The cement-bound macadam shoulder, as built, cost somewhat more than shoulders previously placed, using stone base and bituminous tops. However, further work of this kind on the Cherry Valley highway will result in costs that are equivalent to competitive types.

The personnel on this project were: Guy W. Pinck, district engineer, District No. 3 N. Y. State Highway Department; Charles Fischer, associate civil engineer in charge of construction; David Fitzgerald, engineer in charge of maintenance; and Carl Shultze, in active charge of the project.



Top—Stone ready for grouting. Second—Pouring and brooming grout. Third—Rolling grouted stone. Bottom—Final finishing operations.

KOPPERS IS ...AND HAS BEEN... OPPOSING TAX DIVERSION

WHO ARE THE HIGHWAY INDUSTRY'S REAL FRIENDS?

Highway men are putting up a valiant fight to save the highway program from the results of gas tax reduction and motor license fee diversion.

If ever the industry needed to know who its real friends are . . . it needs to know now.

Neither the Tarmac organization . . . NOR ANY COMPANY ASSOCIATED WITH IT . . . is in sympathy with the movement to reduce or divert taxes or fees intended for highway purposes. We are doing everything we can to help the highway program.

KOPPERS PRODUCTS CO., PITTSBURGH, PA.

KOPPERS
Tarmac
MAKES GOOD ROADS

Published in July, 1934

*In these
announcements
it made its
position
clear*

THIS IS NO TIME TO TAKE BOTH SIDES

In modern business set-ups it is often true that different units of the same corporation may be on opposite sides of a movement.

Because of this, the Tarmac organization wishes to make it plain that it is not associated in any way with any company which desires reduction or diversion of the gas taxes or motor license fees.

KOPPERS PRODUCTS CO., PITTSBURGH, PA.

KOPPERS
Tarmac
MAKES GOOD ROADS

Published in July, 1934

KNOW YOUR FRIENDS

HOW ARE THE HIGHWAY INDUSTRY'S FRIENDS LINING UP?

The reduction and diversion of gasoline taxes and motor license fees are a serious menace to the future as well as the present highway program.

The highway industry is rightly fighting those trends. It has a right to know who stand with it. For that reason, the Tarmac organization makes this public statement that neither it nor any of its associated companies is in favor of gas tax or motor license fee reduction diversion to uses other than for the benefit of those who pay the tax.

KOPPERS PRODUCTS CO., PITTSBURGH, PA.

KOPPERS
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Published in August, 1934

Published in August, 1934

FRIEND OR FOE TO THE HIGHWAY PROGRAM?

The Tarmac organization is not associated with any company which is furthering the reduction and diversion of gas taxes and fees. The Tarmac organization believes that fees are essential to the future development of the highway program.

We believe the highway industry has a right to a similar statement of policy from all such industry.

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Published in August, 1934

Published in August, 1934

IT'S TIME FOR THE HIGHWAY INDUSTRY TO COUNT NOSES

Who can the highway industry depend on, in the present battle over gas taxes and motor license fees?

The Tarmac organization wants to make it plain that it is opposed to the reduction and diversion of taxes and fees intended for highway purposes . . . and that it is not associated in any way with any company which desires the reduction of these taxes.

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How Pennsylvania Secures Good Roads at Low Cost

In the November issue Mr. Tebbs explained the general planning and survey procedure employed in preparing to improve 20,000 miles of rural roads. In this issue he describes construction methods employed in carrying out the improvements.

By P. M. Tebbs

Assistant Chief Engineer, Pennsylvania Dept. of Highways

Grading and Base Course Construction

GENERALLY speaking, the grading is performed by means of power blade graders with a minimum hauling of the grading material. In the rougher country, as is prevalent in Pennsylvania, however, many cuts and fills are required, so that steam shovels must be used and the material hauled.

One of the types of base course developed for economy in construction on this type of highway is known as "modified stone base course." It is designed to use all of a crusher run of material passing a 4-inch circular opening, the coarse material being separated from the fine by passing it over a screen with 1¼-inch opening. The coarse material is placed and the fine material is spread over the surface and thoroughly rolled so as to give a tight uniform surface. Stone, crushed slag and 40 per cent crushed gravel are used under this specification.

Another type of base, known as "native stone base course," is very generally used where local stone and sometimes slag is available. It consists of large pieces napped and wedged in place and the voids filled by the smaller stones and other approved material. The stone is an approved one, sound, tough, durable and free from laminations, clay, loam or foreign substance. The pieces after sledging and napping must be of such shape and size to insure solid bedding. The small stone used for chinking the large stone must be equal in quality to that of the large stone, and, for filling the surface, gravel, stone screenings, crushed or granulated slag or cinders of approved quality may be used.

Many of the old dirt roads are so eroded that they lie in troughs, and it is especially important to lay the grade line so as to facilitate drainage to provide a run-off away from the road bed. Stone drains should be provided for bleeding the base course at frequent intervals. Cross drains should be provided with the same care and frequency as for high type construction.

Shoulders are prepared in advance of placing base course and act as a form for the base and surface courses.

A template is used for checking the crown and contour of the subgrade and base course respectively. Straight edges,

sixteen feet long, are furnished and used for testing irregularities in base course, except that a 10-foot straight edge is used on vertical curves.

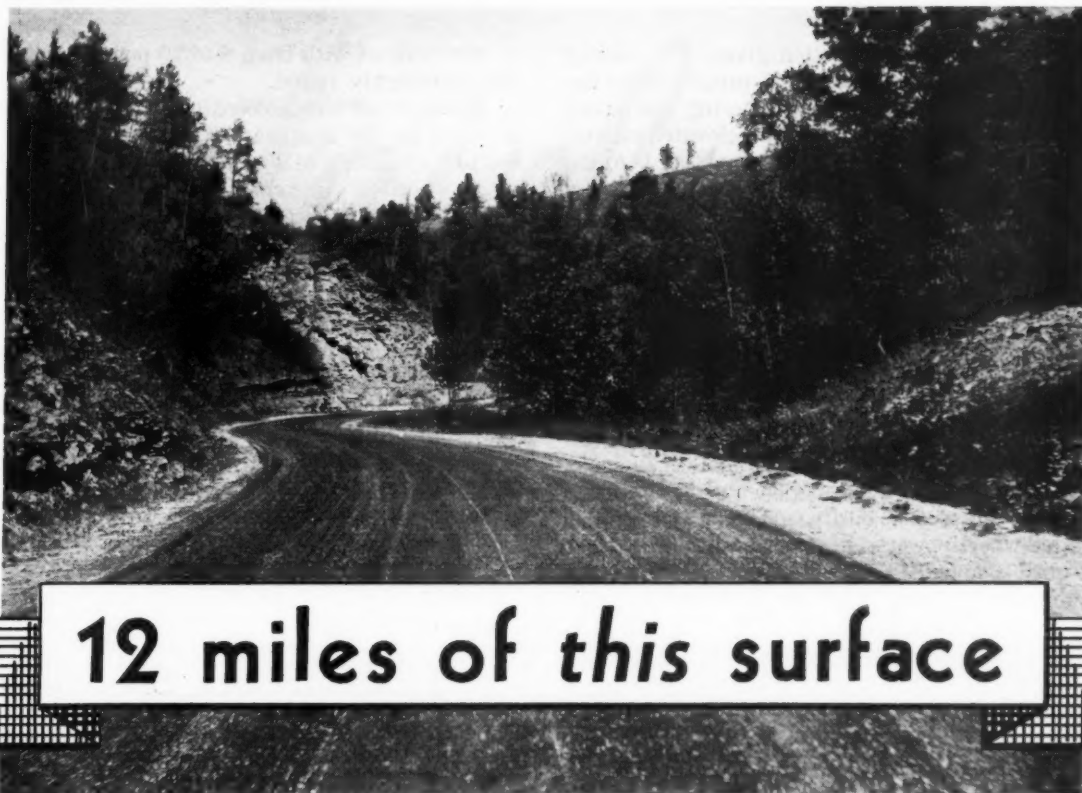
String lines are set on each side of the road along the edges of the proposed pavement at the elevation of the top of the loose stone for this course. These lines are to be removed prior to rolling the stone. At least four sets of five blocks of a depth equal to the depth of the loose stone, spaced 25 feet apart, are used as a guide for the further control of the depth of the base course. One block is placed at each edge of the road under the string lines, one at the center and the remaining two equidistant between the center block and each side block. These blocks are used also in conjunction with the crown board and straight edge.

In lieu of blocks, the templates or crown boards may be equipped with a metal or other approved extension attached to each end so that the bottom of the template or crown board will be at the elevation of the top of the loose stones of the base course. At least three such templates must be furnished, and they should be spaced at 25-foot intervals.

The large stone for this work is dumped in piles or otherwise placed on the subgrade, after which, it is broken to the proper size by sledges or napping hammers. The breaking and spreading of the stone is handled in such a manner as to provide the proper depth and cross section as shown on the drawings. After the stone has been spread in a satisfactory manner, it is rolled with a three-wheel power roller weighing not less than ten tons, until compacted satisfactorily and



Men breaking native stone base course. Distribution (except for photographic purposes) and goggles essential for avoiding eye injuries.



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true to the grades and cross section given. The rolling in all cases is begun at the sides and progresses to the center of the roadway, thoroughly covering the entire surface with the rear wheels. On superelevated curves, the rolling is begun at the low side and proceeds to the high side.

At all times at least five hundred feet of subgrade and shoulders are prepared in advance of the base course operation. If at any time the subgrade material should become mixed with the stone, the mixture is removed, the subgrade reshaped and compacted, and the removed material replaced with clean stone, which is filled and rolled until compacted satisfactorily and uniformly with the surrounding surfaces.

After the rolling of the coarse stone has been completed there is spread over the entire surface sufficient approved material passing a 1¼-inch circular screen to fill the base course. The entire surface is again rolled with a three-wheel power roller weighing not less than ten tons until compacted satisfactorily, and true to lines and grades given. Additional filler material is added and rolled as required.

When the base course is completed it is tested with standard template and straight edges described above. Any irregularities of more than ¾ inch are remedied to the satisfaction of the engineer by loosening the surface and removing or adding material as may be required, after which the entire area, including the surrounding surface, is rolled and compacted satisfactorily.

These stone base courses are generally used in depths of from six to eight inches. Other local materials are also used where they are available, such as run-of-bank gravel; choice, sound shales; and, in some sections, red dog, a brick-like substance which is obtained from shaley culm deposits which have been burned. These miscellaneous types are usually placed in depths approximately two inches greater than the stone foundations.

Surface Course

Various types of surfaces are used. Where a base course of a suitable quality of stone has been constructed eight inches in depth, the surface course may consist of heavy bituminous surface treatment which will thoroughly bind and fill the top surface of the base course and produce a wearing surface approximately one inch deep. Approximately one gallon of bituminous material and from 50 to 100 pounds of stone chips are used in this type of surfacing, and the material is dragged and compacted to give uniform coating and a smooth riding surface.

The type of surface used to the greatest extent is a bituminous penetration course two inches deep.

Two and three-quarter-inch loose approved stone is spread uniformly over the base course. This is a clean stone, 100 per cent passing a 1½-inch screen and not more than 10 per cent passing a ⅝-inch screen. It is then rolled lightly to set it. It is then penetrated with approximately 0.8 gallon of approved tar or asphalt cut back, usually in two applications of approximately equal quantities. The surface is then dragged lightly to facilitate the coating and improve the surface smoothness, after which it is rolled. After the bituminous material has dried out properly (not less than 24 hours) from 10 to 15 pounds of clean stone chips passing a ⅝-inch screen is spread over the surface, followed by a second application of bituminous material at the rate of 0.2 to 0.25 gallon per square yard, and the surface

is then covered with from 8 to 10 pounds of stone chips and thoroughly rolled.

At the proper time, according to the conditions and as directed by the engineer, a third application of from 0.2 to 0.25 gallon of bituminous material and from 15 to 20 pounds of stone chips are applied. It appears to be best practice to place the majority of the chips before the application of the bituminous material, reserving only a small amount to be spread over the bituminous material. This practice provides a more uniform coating, holds the bituminous seal to the surface where it is required, and results in practically no loss of stone chips. In sections where traffic can be detoured, in some cases all the chips are put down before the bituminous material is applied.

During this process the surface is checked and the irregularities corrected so that the finished surface provides excellent riding qualities.

The results indicate this surface course to be the equal of a mixed-in-place surface without requiring the use of the expensive equipment used generally in mixed in-place surfaces.

Hydraulicking Six Million Yards for a Highway

What is believed to be the largest hydraulic operation yet undertaken on highway work has been started in California. The project involves removal of 6,000,000 cu. yd. of material. The rate of removal by hydraulicking is controlled by the amount of water available, and is estimated to be, in this project, 1.5 million cu. yd. a year. To insure even this rate, it is necessary to provide storage to tide over weeks of dry weather, and a reservoir of 600,000 cu. ft. (4.5 million gal.) capacity was constructed.

This unusual operation is being carried on in connection with carrying a highway over Oregon hill, a mass of auriferous gravel which originally contained 200,000,000 cu. yd. About half of this has been removed by hydraulic mining for gold, which began in 1862 and was discontinued in 1918 because it had become unprofitable. In selecting the hydraulic method of constructing the proposed road, the engineers were influenced by the fact that part of the old water system that supplied water for the hydraulicking still existed and could be leased at a nominal rental. This included 12 miles of flume, ditch and 30" hydraulic pipe, with a capacity of 55 cfs. It was proposed to use two hydraulic giants, a 7" and an 8", and as the latter alone uses 60 cfs under the head of 550 ft., the supply is supplemented by a pipe line of 30" and 26" diameter laid from the reservoir, down a ridge to where 18" branches take off to the giants.

Unfortunately, the precipitation last winter and spring was unusually light and the amount of water available this year is below expectations. However, hydraulicking began February 28th, and was continued with an average daily run of 6½ hours. During the first 31 days of operation gravel was removed at the rate of 800 cu. yd. an hour, which is 10.7 per cent of the volume of water used. The unit cost was 4.6 cts. per cubic yard; but as this includes about 40 per cent of non-recurring expense, which will eventually be distributed over a much larger volume of material, the unit cost will probably be well under 3.5 cts. when the job is in full swing.

Certainly..

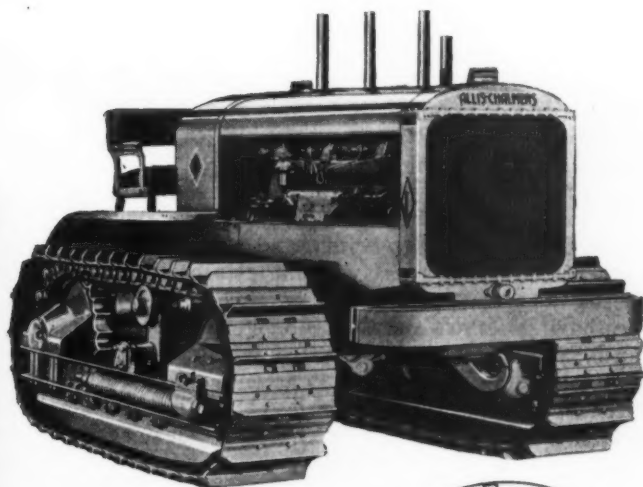
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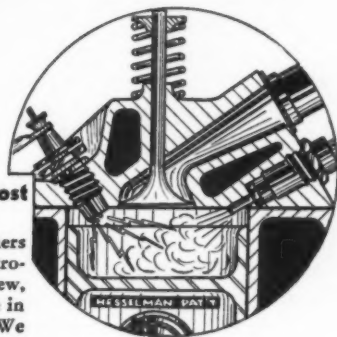
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TRACTOR DIVISION—MILWAUKEE, U. S. A.

A Year's Experience in Sewerage and Sanitation*

By E. R. Howson

Of Alvord, Burdick & Howson, Engineers

DUE TO the economic conditions prevailing during the past year there was a relatively small volume of sewage treatment plant construction; but during the past few months there has been a decided impetus to such construction growing out of the Public Works Administration allotments, nearly 700 cities having received allotments for such work involving a total expenditure of well over \$200,000,000. Construction contracts have been let on many of these and work is now actively under way. Only a few cities have proceeded with sewage treatment plant construction during the year without Federal aid.

Financing of such work in several states has been curtailed by state laws limiting debt-incurring and taxing capacities of municipalities, which has been solved by sewer revenue bond and sewer service charge legislation, 35 states having laws permitting collection of charges for sewer service. Such charges are now in force in several hundred cities—over 200 in Texas, about 25 each in Ohio and Pennsylvania, and smaller numbers in other states. Experience with the plan has been unexpectedly favorable; in Dayton, O., one of the largest cities having service charges (48,500 accounts), less than 0.5% are delinquent. Some state courts have decided that sewer revenue bonds are not a lien on the borrowing capacity of their cities. Until this matter has been adjudicated in the other states, cities in those states may find difficulty in selling such bonds.

Tanks

Developments in settling tanks have been directed toward securing more efficient distribution of flow and sedimentation. Studies have been made under operating conditions of inlet and outlet baffles, cross currents, and other possible causes of unequal distribution. At Dearborn, Mich., Hubbell, by redesigning the inlets of Imhoff tanks increased their efficiency in removing suspended solids from 48% to 74%, the suspended solids in the effluent of said tanks being reduced from 83 ppm. to 47, with undoubtedly considerable increase in B. O. D. removal. Sperry at Aurora increased removal of suspended solids approximately 14% by installing deflectors which changed the flow over the weir from a spiral rolling effect to one normal to the weir.

Each of the two largest manufacturers of equipment for sewage treatment plants has developed designs for *center-feed*, *radial-flow* square tanks, and several have been installed, giving the increase in operating efficiency theoretically resulting from a gradual enlargement of cross-section from inlet to effluent channel. At the Morrell Packing Co., Sioux Falls, where a side-feed cross-flow clarifier had removed 25% of the suspended solids with one hour retention, a center-feed, peripheral-flow tank with the same capacity and retention period removed 60%.

Practically all tank construction now is of the separate sludge digestion type with mechanical appliance for collecting and removing sludge. Imhoff tanks are rarely built at present in this country.

Sludge Digestion and Gas Utilization

There have been no new developments in sludge digestion. *Heating* is commonly by hot water circulated through coils. Keefer has found this more efficient than direct addition of hot water. General operating experience indicates that optimum digestion temperatures for most solids may lie anywhere between 80° and somewhat above 100°F; there being within this range apparently little variation in the character of sludge produced, rate at which digestion occurs, amount of gas produced, or character of gas.

Different plants treating wastes not greatly complicated by industrial processes obtain fairly uniform results in *gas production*—ordinarily 11 to 12 cu. ft. from each pound of volatile matter in the sludge added to the digester, and 20 to 23 cu. ft. per pound of volatile matter destroyed in the digestion process where there is adequate digestion capacity. As the gas normally contains 600 to 700 B.t.u., and this gives 12,000 to 14,000 B.t.u. per pound of volatile matter destroyed, the efficiency of the process is apparent.

Marked advancement in the *utilization of sewage gas* is perhaps best illustrated by the plant at Springfield, Ill., where Walraven has done much pioneer work. This plant, treating activated sludge from 70,000 people, produces about 0.6 cu. ft. per capita per day. A 180 h.p. gas engine connected to one of the blowers has operated almost continuously during 1933 and up to the present time, producing about 65%—in some months 90%—of the power required for aeration and the saving already has completely covered the cost of installation. The engine's exhaust gas and cooling water heat the water circulated through the coils in the digesters, maintaining the temperature in the digesters at 80° to 100°. Other plants, notably those at Rockville Center and Newark, N. Y., Ft. Atkinson, Janesville and Madison, Wis., Cedar Rapids, Ia., and Peoria, Ill., have units either now installed or being installed for utilizing gas in engines. In a number of plants, as at Erie and Lancaster, Pa., Aurora and Rockford, Ill., gas is used for incinerating screenings and scum; also for operating auxiliaries driven by small gas engines for laboratory use and in at least one case for operating the laboratory's gas-type refrigerator.

Sludge Treatment

Sand beds, open or glass-covered, are used for drying sludge by most communities, at least those of 100,000 population or less. In the northern half of the country open beds can be filled 5 to 7 times a year and glass-covered as high as 20. Ordinarily the latter are designed of about half the area of open beds. It is believed that the use of glass-covered beds is increasing in localities where odor nuisance may be a factor.

Practically all the larger cities are considering *filtration of sludge*. Apparently Chicago is the only one seriously considering filtration of undigested sludge, experimental work there by Mohlman indicating that fresh sludge filters on vacuum filters at higher rates and with less expense for coagulant than does digested sludge.

*Condensed from paper before American Society of Municipal Engineers.



A HIGHWAY PLATFORM

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- 1.** That every highway project show economic justification for the proposed outlay.
- 2.** That fair distribution of highway benefits be made between urban and rural citizens.
- 3.** That conservation of existing highway improvement requires utilization of old pavements as bases wherever practicable.
- 4.** That in the interest of economy maximum use of local materials be encouraged.
- 5.** That wherever practicable highways be progressively improved by stage construction to keep pace with traffic needs.
- 6.** That subgrade stabilization be urged as a means of assuring durable highways at minimum cost.
- 7.** That the Federal Government be urged to amend Federal Aid legislation to extend Federal Aid regularly to farm-to-market roads in a fair proportion to trunk lines.



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In practically all experiments on sludge filtration, as by Gascoigne at Cleveland, Keefer at Baltimore, at Columbus, Hagerstown, Md., etc., all using digested sludge, it has been found necessary to use some *sludge-conditioning* agent. Ferric chloride has been most extensively and satisfactorily used. Elutriation at Baltimore has given higher filter capacity and coagulant economy.

At Hagerstown, Md., one of the few smaller cities attempting *vacuum filtration* of sludge, when the sludge is conditioned with ferric chloride and lime it is practicable to produce a filter cake averaging 80% moisture with 71% volatile solids, which is entirely free from offense when spread on land.

On the basis of present experience, it would seem desirable, except in possibly the very largest installations, to retain digestion in connection with vacuum filtration, as the digestion tank serves to iron out inequalities of sludge supply (particularly necessary with combined sewers) and provide insurance against breakdown of filter equipment.

To date, mechanical drying and incineration are being seriously considered by Chicago only and even there with hesitancy. An experimental 20-ton plant was operated there for several months, and while the resulting clinker was entirely free from odor, it was not practicable wholly to eliminate odors. Raw sludge filter cake with a moisture content of 70% or less could be incinerated substantially without fuel.

Chemical Precipitation

Up to the present time none of the various chemical precipitation methods has been applied in large plants, but several small plants have used them, particularly on industrial wastes, and considerable experimental work has been done. There seems to be a growing appreciation of the usefulness of chemical precipitation as an additional step following preliminary treatment where normally dilution is adequate for the effluent from the preliminary treatment, but where occasionally, as during dry seasons, further treatment is necessary to prevent nuisance, and a relatively high operating cost for short periods is justified. It is understood that on the large Minneapolis-St. Paul project consideration is being given to chemical precipitation as well as activated sludge, operation of which will be required only during seasons of low flow.

The *Laughlin* process in use at Dearborn attracts great attention as it most closely approaches an application to domestic sewage on a plant size scale, and apparently has demonstrated its ability to produce an effluent with a remaining B.O.D. of from 20 to 25 ppm, which indicates its applicability from that standpoint to many locations.

The *Guggenheim* process, also, has demonstrated at experimental plants its ability to turn out a high-grade effluent with a reduction in B.O.D. of from 80 to 90%, and in suspended solids of from 97 to 99%.

Scott at Oklahoma City has greatly increased the sedimentation of a difficult sewage, by use of *ferric chloride*, which he prepares from chlorine and iron stripings. But in general, engineers are employing established methods—plain settling and digestion of sludge, with secondary treatment, where needed, of activated sludge, or sprinkling filters, the latter especially in small installations.

Chlorination

The use of chlorine is increasing for sterilizing effluents discharging near bathing beaches or water supply intakes. The A. P. H. A. committee on sewage disposal

reported that where chlorine is applied in amounts sufficient to give residuals of $\frac{1}{4}$ to $\frac{1}{2}$ ppm after ten minutes, a reduction in B.O.D. may be expected of at least 2 ppm for each 1 ppm of chlorine absorbed, which for normal doses with domestic sewage would be equivalent to effecting a reduction in oxygen demand of from 15 to 35%. Also that applying heavy doses to sewage would have beneficial effects upon down-stream conditions.

Activated Sludge

Activated sludge treatment seems to have lost none of its popularity because of the adverse patent decision at Milwaukee by Judge Geiger, sustained by Judge Lindley of the U. S. Appellate Court. In spite of the patent suit against the Chicago Sanitary District (not yet decided) it is proceeding with the construction of the Calumet and Southwest plants, and Cleveland and many smaller cities are constructing or planning such plants. This treatment is continually increasing in its field of application, with possibly wider use of mechanical aeration in the smaller plants. An ultimate decision and establishment of definite basis regarding royalties will probably give added impetus to this type of treatment.

Refuse Collection and Disposal Costs in England

"The way to obtain the best results at the lowest cost (in refuse collection and disposal) is by employing a fully competent staff under specialized technical direction, strict costing, and close application of the lessons learned by local authorities from the examination of their own experience and that of other authorities." This is the opinion of the Ministry of Health of England, which it finds again confirmed by the annual reports for the year 1932-1933 made to it by 329 cities and boroughs of England and Wales.

Of the various municipalities reporting, 118 actually weighed 80% or more of the refuse; of the 27 metropolitan boroughs, 24 did so. The average weight per capita per day was 1.71 lbs., ranging from 1.46 lbs. for cities of 200,000 and over to 1.87 lbs. for those under 30,000. The cost of collection averaged \$2.15 per ton, and of disposal, \$1.04. The costs per 1,000 population averaged \$605 for collection and \$280 for disposal; these figures including loan or depreciation charges and expenditures for new plant out of revenue; income deducted."

Classifying the average weights by towns which did or did not weigh at least 80% of all refuse, the report shows that for 118 which did, the average per capita weight was 1.39 lbs.; varying from 1.53 in the metropolitan boroughs to 1.23 in urban districts.

In towns which weighed the refuse, the cost of collecting it averaged \$2.50, and of disposing of it \$1.71 per ton; varying from \$2.23 in the metropolitan boroughs to \$1.56 in the county boroughs.

Truck Operation by St. Paul Water Department

The water department of St. Paul, Minn., in 1933 operated 18 trucks and three other cars. The trucks made a total mileage of 159,420, with an average of 8.7 miles per gallon of gas. The average cost per mile was 6.4 cts., and per month \$47.52; these costs including gasoline, oil, tires and other supplies; service, repairs, parts and accessories; depreciation, insurance, and garage and shop charges. The depreciation charged averaged about 25% of the total, maintenance 24%, operation 32%, insurance 10% and overhead 9%.

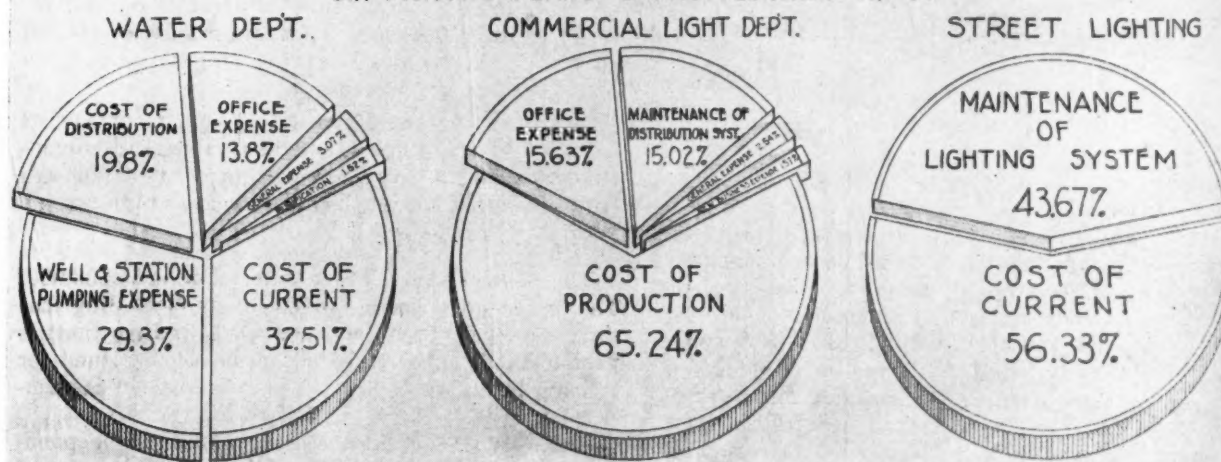
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ALLOCATION OF DEPARTMENTAL EXPENSES

SIX MONTHS PERIOD ENDING FEBRUARY 28, 1934



Joint Operation of Water and Light Plants in Lincoln, Nebraska

By Paul W. Doerr

Superintendent Water and Light Dept., Lincoln

LINCOLN, Nebraska, has a population of more than 86,000. The city government is divided into five departments, each of which is in charge of one of the five councilmen, who is called the superintendent thereof. One of the departments furnishes water and street and commercial lighting,—in the last of which it is in competition with a privately owned plant.

The Water Plant

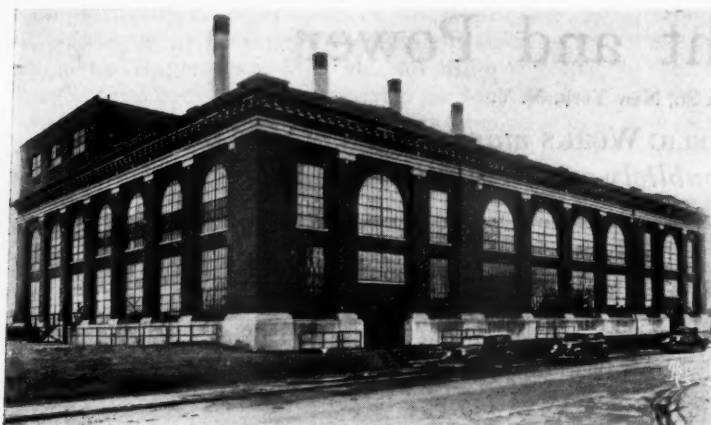
The municipal water plant dates from 1881, when the citizens voted \$10,000 for that purpose and a well supply was installed. Additional well supplies were installed in 1888, 1891, 1892 and 1914.* One built in 1892 at 30th and A streets is the largest and main pumping station of the city today, while the second largest is that at 17th and Van Dorn streets built in 1914. In 1919, the citizens voted \$200,000 bonds for extensions, but because of financial and legal difficulties these were not marketed until 1922, when \$100,000 was made available. To meet the 5% interest on these bonds and provide for retiring them, the department contributes each year from its earnings to a sinking fund. Other wells and a pumping station were built in 1926; but the water turned salty and the wells were abandoned; the pumping station, however, continued to be used to house booster pumps.

*The plant as it was then was described by this journal (then called "Municipal Journal") in its issue of November 26, 1914.

Water from the several sets of wells is pumped into large underground concrete reservoirs with concrete roofs, most of which are located near the A Street station referred to above, and which can be emptied by gravity into a pump well. (One set of wells, along the Antelope valley, delivers into these reservoirs by gravity.) Here pumps force water into the distribution system, maintaining a pressure of 55 to 60 pounds in the business section, raised to 90 to 110 pounds for fire fighting.

During the years 1926 to 1930 four suburban cities were annexed to the city, adding a total of 10,600 to the population, and addition to the water supply was necessary. The Burns & McDonnell Engineering Co. was engaged to investigate sources of supply and recommended going to the Platte river near Ashland, about 29 miles from Lincoln, which plan has been put into effect. The city voted \$2,300,000 bonds for the purpose in April, 1931, but owing to the depression these were not sold at once, but such funds as were needed were furnished from time to time from the surplus earnings of the Lighting Department, which purchased the bonds as a part of its sinking fund investment. Water from the Platte river reached Lincoln in August, 1932.

The new supply is obtained from the underground flow of the Platte river through five wells located about



Main station, Lincoln, Nebraska

half a mile from the river itself, and 2,000 feet apart, drilled from 85 to 47 feet deep to bed rock. Each well is provided with a 2 mgd well turbine pump. The water is pumped 3.72 miles through 24- and 36-inch cast iron pipe to a 3 mg reservoir at Ashland. From here to Lincoln the water flows through 25.1 miles of 36-inch cast iron pipe. The cost of the entire 28.82 miles of pipe was \$1,520,437, and the total cost, including land, wells, pumps and pumping station, and engineering, was approximately \$1,800,000.

Automatic cluster air relief valves are placed at all summits, enclosed in concrete vaults, and 8-inch blow-offs at all low points. Access manholes are placed at 2,000-foot intervals along the pipe line. The pipe was laid with a minimum depth of cover of 4 ft. (at stream crossing siphons) to 16 ft. Most excavating was done with a trench-digging machine, the ditch being 5 ft. wide. Calking was done by compressed air. Where the 36-in. pipe passed under railroad tracks it was placed in a 72-in. culvert filled with dry sand.

Specifications permitted a maximum leakage of 100 gal. per inch-mile at the end of two years. Tested in five sections under pressures of 50 to 100 lb. per sq. in., the maximum leakage was 15.95 gal., and the average for the entire pipe line 11.18 gal.

To pay for these improvements, bonds for \$1,100,000 were sold and the balance was taken from the accumulated savings of the Water and Light Departments. \$100,000 of the bonds have been bought back as a sinking fund investment.

The water is chlorinated. It has a temporary hardness of 80.0 and permanent hardness of 57.4. There is now under construction at Ashland a 12 mgd iron and manganese removal plant at a cost of \$215,000.

The plant now contains 15 reservoirs in the city with a combined capacity of 35,500,000 gallons, besides the one at Ashland. The pumping capacity totals 51.5 mgd, consisting of one 2 mgd and one 8 mgd Allis-Chalmers centrifugal pumps, one 3 mgd Fairbanks-Morse centrifugal, one 3 mgd and one 0.25 mgd Dayton Dowd centrifugals, four 3 mgd and one 1.5 mgd American centrifugals, one 0.75 mgd Manistee centrifugal, one 15 mgd DeLaval steam turbine driven centrifugal, and one 6 mgd Snow steam pump. There are 385 miles of 4 in. to 36-in. mains, 20,495 services, of which 18,264 are metered. The average daily consumption is 98 gal. per capita; the maximum for one day (July 20th, 1934) was 230 gal.

Electric Service

The municipal street lighting department has been in continuous operation since 1905; and since 1913 the

municipality has been selling light and power in competition with a privately owned plant and now serves about one-third of the light and power consumers and furnishes all the street lighting. In 1920 the people voted \$300,000 bonds for the lighting services and in 1922 \$100,000 of this was allotted to the street lighting and the same amount to the commercial department. (The two are operated separately as to finances.) The street lighting is financed by taxation, but the commercial lighting service provided from earnings a sinking fund to pay interest and redeem the bonds. There are slightly over 4,000 street lamps in service, ranging from 1,000 to 10,000 lumens.

The electric generating equipment consists of one 4,000 kva Allis-Chalmers turbo-generator, one 2,900 kva Allis-Chalmers, one 2,000 kva Allis-Chalmers, and one 750 Kerr steam-driven turbine generator.

Financial

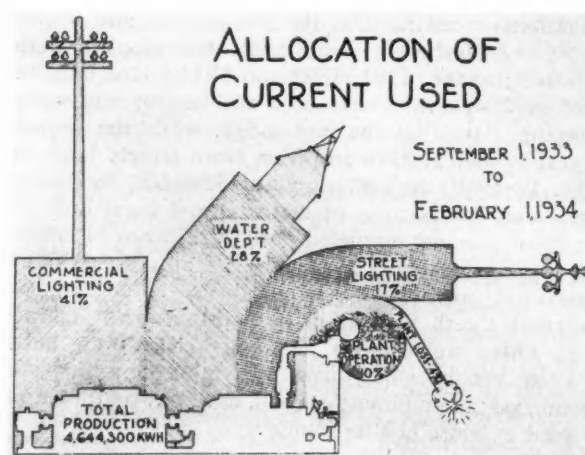
The estimated value of the water plant is \$6,500,000. The present total bonded indebtedness (including that for the new filtration plant now under construction) is \$1,849,000. There is \$236,958 in the sinking fund for retiring bonds, and \$154,661 cash balance on September 1st, 1934.

The total revenue for the fiscal year ending September 1st, 1934, was \$349,224, and the total operating and maintenance cost \$117,701.

The meter rates are 15 cts. per 1,000 gal. for the first 335,000 gal. per month, 13 cts. for the next 2,665,000 gal., and 10 cts. for all over 3,000,000 gal. The minimum charge per month is 50 cts. for $\frac{5}{8}$ and $\frac{3}{4}$ -inch meters, \$1.50 for 1-inch, \$5.00 for 1½ and 2-inch, \$10 for 2½ and 3-inch, \$15 for 4-inch and \$30 for 6-inch.

The rates for commercial lighting and power are 40 cts. per month fixed charges plus 5 cts. per kwh for 1 to 10 kwh, 4 cts. for 11 to 40 kwh, 3.5 cts. for 41 to 500 kwh, and 3 cts. for all over 500 kwh; with 5% discount if paid before the 10th of the month. The service is more than self-sustaining and has no bonded indebtedness. On September 1st, 1934, the balance on hand was \$339,772. For the six months period ending February 28, 1934, the revenue from metered sales was \$89,572; from current transferred to the water department, \$19,343, and to the street light department, \$11,820. The operating expenses comprised \$36,788

(Continued on page 58)



Trends in Water Works Practice

*Indications from the past year's experience—
continued from the November issue*

By Paul Hansen



*W & T Ammoniator to
meter anhydrous ammonia*



*W & T dry feeder for applying
ammonium sulphate*

THERE is a marked trend toward pumping by electric power, even in pumping stations of relatively large size. A number of factors have created this trend which may be enumerated as follows:

1. Increase in the number of power plants and improved network of power lines has created a reliability of service that makes shut-downs rare and but momentary. Such shut-downs can readily be tided over as a rule by moderate elevated storage.

2. Centrifugal pumps have been developed with such high efficiency that purchased electric power compares favorably with the most efficient steam pumping machinery.

3. Electrically operated pumping stations are clean, neat, and inconspicuous, thus permitting their location within or adjacent to residence districts.

4. Development of the internal combustion engine has created a compact, economical, and reliable standby source of power, thus adding to the security of using transmitted electric power.

5. Electrically equipped stations require a small personnel for operation and maintenance.

6. Centrifugal pumps require relatively little repair work. Generally speaking, when they fail to maintain their efficiencies or otherwise get out of order it is feasible to quickly obtain any parts, or even an entire new pump, from the factory promptly and at relatively small cost.

7. Electrically equipped pumping stations lend themselves to automatic or remote control, so that it is feasible to build stations of relatively large size which require no attendance except for periodic inspection.

Within recent years much more attention has been given to piping of pumping stations. A carefully designed modern electrically equipped pumping station is equipped with a loop arrangement for the discharge piping so that if any pump, any piece of pipe, or any valve is out of service, it is still feasible to operate most of the pumps. Attention is also given to multiple connections to the distribution system, so arranged that if any pipe or valve fails, water can always be delivered in reasonable quantities from the pumping station into

the distribution system. In cases where the water comes to the pumping station through a pipe line, suctions of the pumps are also looped; but generally speaking, adequate security can be obtained by providing independent suctions for each pump, or at least duplicate suctions for a group of pumps.

Purification Works

Engineers, chemists and others specializing in water purification have been working intensively for the last four or five years on such matters as (1) improved coagulation, (2) elimination of tastes and odors, (3) removal of color, (4) maintaining the sand bed of filters in much better condition than was formerly considered necessary, (5) more effective sterilization, and (6) production of a water that will not corrode or encrust mains or interior piping.

The last few years have shown much greater interest on the part of the general public in soft water. The means of softening water have improved, and the chemistry of softening water has become better understood. Zeolites are finding a greater and greater application to municipal water softening, but the so-called lime and soda processes still remain the most suitable and economical for most municipal water supplies.

Chemical Preparation and Application. None of the features embodied in modern water purification plants can be regarded as revolutionary, yet the last five or six years have resulted in a number of improvements in detail. The designer of today puts much more thought into the chemical preparation and feed devices than was done a few years ago. More space is devoted to the chemical feed equipment and piping arrangements are more carefully designed, all with a view to securing greater accuracy of application, greater flexibility in point of application, and better control of dust and fumes.

For example, a modern water purification plant (not including softening) should comprise the following facilities for chemical preparation and application:

1. Dry feed machines in duplicate or multiple for the application of alum, ferrous sulphate, ferric sulphate, or sodium alluminate.

2. Machines in duplicate or multiple for the application of lime. The lime may be used in conjunction with

ferrous sulphate or it may be used to provide necessary alkalinity in connection with the use of alum. It may also be used to remove carbon dioxide from the filtered water for the correction of corrosion in pipes.

3. Machines for the application of activated carbon in powdered form. These machines should be in duplicate or multiple and should be so arranged that the carbon may be applied at various points in the preliminary treatment of the water. Activated carbon is extremely dusty, and these machines, as well as the carbon storage, should be enclosed in dust-proof compartments.

4. Machines for the application of chlorine and ammonia. Chlorine machines should be placed in a separate room with a special ventilating fan so that in case of chlorine leakage the room may be independently ventilated. Ventilating fans should have remote control. Ammonia may be applied either in the form of anhydrous ammonia or as ammonium sulphate. In the former case, equipment similar to chlorine feed machines are used and in the latter case dry feed chemical machines may be used. The chlorination and ammoniation equipment should be so arranged that there may be pre-chlorination and ammoniation of the raw water and post-chlorination and ammoniation of the filtered water. In some cases it is desirable to apply the chlorine and ammonia at some intermediate point.

Chemical feed piping should be as short as possible and so placed that it can readily be removed for cleaning. Rubber tubing is desirable for the longer runs, inasmuch as this may be easily removed and the incrustation within may be broken by simply walking on it. It is desirable to have an open inlet flume in which the chemicals are applied to the raw water. This permits of easy accessibility and also permits the operator to observe the mixing of the chemicals. Further, it permits of application of chemicals in any order deemed desirable by the operator by simple re-arrangements of the chemical piping.

Probably no part of a purification plant is so frequently modified as the chemical treatment. It is therefore desirable to so arrange the chemical application devices that they can be changed from time to time. It is also well to provide space for the erection of cheap

chemical solution tanks for the purpose of trying out experimentally some new chemical treatment.

Mixing and Sedimentation. During the last few years a marked tendency has been observable toward improved preliminary treatment of water. Waters containing heavy turbidity, especially if this is readily settleable, is passed through preliminary sedimentation basins, with or without the aid of coagulation, which sedimentation basins are equipped with mechanical devices for removing the sediment as rapidly as it forms. Improved coagulation and sedimentation is obtained by prolonged gentle mixing of coagulants with the raw water or pre-settled water. Formerly baffled mixing chambers were prevalent, but recent practice is definitely toward mechanical mixing devices which can be controlled as to speed, thus permitting adjustment of the mixing action independently of the volume of water flowing through the plant and with minimum loss of head.

During the past ten years there has been a tendency toward longer periods of sedimentation. While it is quite possible to operate filter plants with relatively short periods of sedimentation, the longer periods act as an effective stabilizer to operation. Relatively long periods of sedimentation avoid rapid clogging of the filters, and facilitate meeting any unexpected or unusual conditions that may arise. Sedimentation periods of less than 4 hours are rarely recommended for any kind of water. Periods of more than 8 to 10 hours are seldom needed.

Filters. Practice of the last few years is characterized by more vigorous washing of filter sand and the use of a somewhat larger size of sand grain. Designs now provide for rates of application of wash water as high as 42 inches vertical rise per minute within the filter. Until a few years ago a rise of 24 inches was regarded as ample. Renewed consideration is given to surface washing of the sand, as there is considerable evidence that combined surface wash and upward flow of wash water from the bottom of the filters is effective in discouraging the formation of mud balls. Engineers dislike to provide an elaboration of piping for surface wash, but it is desirable to so design filters that provision for surface wash can be installed later if found necessary. More is being learned by operators as to the technique of washing filters, and even with old equipment they are maintaining better conditions than formerly. One element in this technique consists of breaking up the surface mat of a filter prior to using the upward wash. This may be done by air agitation, raking, use of a hose nozzle, or by a fixed spray for surface wash.

Housing. There is a marked tendency to improve the appearance of water works. In some places large sums have been spent upon architectural effects. Notable new plants with architecturally attractive superstructures are those at Detroit, Fort Wayne, Youngstown, and Wilmette, Ill. There is practical value as well as aesthetic value in housing water works in beautiful buildings. It re-acts on the pride of the operators, it is an object lesson to the general public in emphasizing the importance of an adequate and pure water supply, and it is further justified as an artistic addition to the public buildings of a modern municipality. There is no reason why water supplies should not be enshrined in temples of beauty as was the practice of some of the ancients. However, there is always the ever present practical and financial question as to how far it is proper to go in the matter of architectural embellishment.



Corpus Christi, Tex., filters, International variable rate chemical feeders.

Better Lighting Pays Its Way

Sell more electricity by showing users the advantages of proper illumination

By L. A. S. Wood

Manager, Lighting Division, Westinghouse Electric & Manufacturing Company

BECAUSE better illumination does cut costs, increase efficiency, reduce accidents and establish better working conditions, lighting in industrial plants everywhere will probably be revolutionized in the next few years. At present industrial lighting averages less than 5 foot-candles, one survey of 2,000 industrial plants even averaging below 3, as compared with the safe minimum of 10 foot candles. Industry is awakening to advantages of better lighting as a result of recent developments in lighting and many industrial lighting surveys. The following are a few examples which you can use to show industrial users how proper illumination definitely increased production.

Better Illumination Increases Efficiency

One of the most conclusive proofs that good lighting pays its cost is furnished by a national piston company. This plant was inadequately lighted and the local power company induced them to make a lighting test. The president reports that at the beginning of the test the plant was running at about 70 per cent capacity with a lighting intensity of 1.2 footcandles. In one department the lighting was stepped up to 6½ footcandles and production increased 13 per cent. Then it was further increased to 9 footcandles and an additional 4.9 per cent increase was obtained. Finally the lighting was increased to 14 footcandles and production jumped another 6.9 per cent. In all, the lighting of 14 footcandle intensity increased production 25.8 per cent over the old installation.

In the inspection department of a large roller-bearing manufacturer a thorough test of the effectiveness of light in increased production was made. The original system of lighting provided 5 footcandles at the inspection table. The number of pieces inspected per hour per operator was 408. When the new lighting installation providing 20 footcandles was in operation, production jumped to 458 pieces per hour per operator—an increase of 12½ per cent. This intensity was maintained for two weeks, then decreased to 13 footcandles, and immediately production dropped to 440 pieces per hour per operator. When it was later set back to 20 footcandles production increased to its peak.

Adequate Lighting Pays

In a hosiery plant proper illumination was installed and immediately production of knitting machines jumped 10.8 per cent and of looping machines 6.1 per cent. The cost of the installation was only four-tenths of one per cent and the operating cost one-tenth per cent of the yearly payroll.

In the composing room of a large register company the lighting was old-fashioned, inadequate and spotty. Men at work setting type were slow and errors were common. The management consulted a lighting specialist and he recommended an entirely new system with

modern equipment and Mazda lamps of proper size. After the new installation was made a careful check was kept; production increased 6 per cent and only 20 cents per day was added to the light bill.

In a plant operating a battery of wire drawing machines a haphazard system of drop cord lighting was replaced with a scientifically planned overhead system. Immediately the output of the machines was increased 21 per cent.

A manufacturer of automobile parts reports that after installing a new lighting system which increased lighting intensity 133 per cent, labor turnover dropped from 6.37 per cent per month to 2.78 per cent per month. In addition, work was speeded up enough to completely pay for the installation in 18 months.

10 Foot Candles Required

The development of the light meter which is a portable compact means of measuring lighting intensities, makes it possible to easily and accurately check the intensity of light provided by artificial illumination in industrial plants everywhere. Illumination research laboratories have discovered by actual test that wherever eyes are used for work that 10 footcandles is an absolute minimum. Further tests have also revealed that working under intensities less than 10 footcandles causes not only severe eye strain but results in fatigue, sleepiness, nervousness, headaches, indigestion, etc. Glare from light sources in the line of vision, reflections from glossy surfaces and uneven distribution of light are also features which contribute to this condition.

As a general promise to a new lighting approach to industry, Westinghouse is making three definite recommendations: (1) increase intensities, (2) abolish glare, (3) provide uniform distribution.

Adequate lighting is a working tool in any plant. The importance is best summed up in an adaptation of a well known adage "As a man sees, so does he work."

Industry has spent tens of thousands of dollars in developing machines of greater efficiency, but the most delicate machine is not half as sensitive as the operator. And when conditions are such that it is difficult to see, when surroundings are dark and gloomy, operators cannot be expected to get the most out of machines. Production suffers. Costs increase. Accidents increase.

Better Lighting, Better Work

Other important considerations are the new industrial codes under which industry is working. Shorter work days and shorter work weeks have necessitated the addition of more shifts and the employment of more men. Better illumination enables employers to get a greater volume of work and greater accuracy from each employe under the shorter hours and perhaps increased pay.

But not only does better lighting mean increased

production, it also means better work. Employees can see better, but equally important they have a more inviting, improved working condition and plant atmosphere. A dark, gloomy plant is depressing to workers and they cannot be expected to do their best in surroundings of this character. Better light will increase the morale of the entire staff to a pitch which assures good work, high efficiency. Also, workers are more dependable in well-lighted plants, and more satisfied to stay on the job—therefore, labor turnover is substantially reduced.

Another important advantage of modern lighting in industry is that it makes all space available for active production. With spotty and inadequate illumination there is a large percentage of modern plant floor area which is dark and useless for actual production. The machinery and production line must be grouped close to existing lighting units, leaving large areas which are useful only for storage purposes, et cetera. These areas can be transformed immediately through installation of modern lighting to useful productive activity. Machinery can be arranged for efficient production, and in many cases more machinery and men can be employed in a given plant area. Also, in a plant where dark corners and out-of-the-way spots exist, there exists the opportunity for workmen to seek these spots for idle, unproductive moments.

Lessens Accidents

Improved lighting also means decreased accidents. Workmen who can see danger rather than merely sense it are less likely to be involved in accidents. And accidents in addition to their regrettable nature cost industries large sums of money year after year.

One of the most interesting descriptions of the relationship between lighting and accidents is found in the Code of Lighting prepared under the direction of the Illuminating Engineering Society.

This report points out that the National Safety Council estimates that the number of fatalities in the United States arising out of or in the course of gainful employment was 24,000 for the year 1928, and that during the same period the lost time non-fatal accidents reached the staggering total of 3,125,000. The report also points out that a prominent insurance company admit a warrant for assuming that defective vision and deficient or unsatisfactory lighting installations are contributing factors of 18 per cent of these accidents. This means that from these causes industries are being deprived of the equivalent of the services of 35,000 men throughout each entire year due to lost time non-fatal accidents. This is indeed a high price to pay for neglect of light and vision.

Quoting further from this report it is discovered how from a dollars and cents standpoint accidents cause industry thousands of dollars a year.

"Compensation insurance premiums for a plant are based on the amount of the payroll, and the rate is determined by the accident experience of a given industry, modified by the experience of a particular plant under consideration. With a rate of $1\frac{1}{2}$ per cent the annual premium in the case of 1,000 employes at an average wage of \$40.00 per week would be \$31,200.

"An insurance carrier might at an average pay the claims resulting from four accidents per month in this plant, and meet its own overhead cost, and still have slight margin of profit. An experience of five accidents per month, one-fifth of them due to improper lighting (a not unlikely event) would probably leave the insurance carrier no option but to increase the rate by 25

per cent. This premium could then be \$39,000 an increase of \$7,800. If poor lighting costs only \$3.00 per employe or \$3,000 per year total, the owner's annual expense for poor illumination actually amounts to \$10,800—of which \$7,800 is required by the insurance company to meet additional accident claims. An expenditure of \$6.00 to \$8.00 per year per employe for more adequate illumination might save a large portion, if not all, of the latter amount. The important point here is the fact that the cost of accidents, due to poor illumination, greatly exceeds the cost of providing adequate illumination."

From the foregoing facts it is readily evident why it pays industry to improve its lighting standards.

The lighting industry for years has had the equipment to make possible illumination as now recommended. But it has only been recently that any one has fully appreciated the intimate relationship between light and sight and human efficiency. By bringing these facts to the attention of their customers and urging them to make similar tests, municipal light and power plants have a means of increasing the use of electricity which will benefit all concerned.

How One Privately Owned Lighting Company Met a Request for Lower Rates

Some years ago the citizens of a city of about 30,000 population in New York State complained about the rates for electric current. At that time a fair percentage of the population was installing oil heaters and other electric appliances for home use, thus materially increasing the consumption of electric current. The local company supplying both electric current and gas is wholly owned by one of the large public service corporations and has a franchise from the city.

The protest on rates, while not particularly vigorous, was sufficient to cause the council to take the question up with the officials of the lighting company who are purported to stand in with the political party in control of the city administration.

After what was evidently a very friendly conference, it was agreed that a lower and considerably more reasonable rate would be made to householders provided they install an additional meter for the current used exclusively for power, the meter and installation to be paid for by the householder, at the cost, for an ordinary dwelling, of from \$60 to \$80. Apparently the lighting company does not get any part of this outlay unless it makes a profit on the meters, which are bought from it, but the stipulation that power meters must be installed prevents a great many users of current from benefiting by the lower rate; which, obviously, was the reason for requiring an additional meter.

The rate for "small power installations" that was agreed upon and is in use today is:

For first 30 kwh per month, 10 cents per kwh.

For all over 30 kwh, 3 cents per kwh.

Minimum charge per month per horse power or fraction thereof of rated capacity of installation.

Compare these rates with those of the municipal plants in Lincoln, Neb. and Jamestown, N. Y.

The rates for residential light in the city referred to are:

For the first 8 kwh or less.....\$1.00

Next 22 kwh per meter per month..... .08

Next 170 kwh per meter per month..... .06½

For all over 200 kwh per meter per month. .05

Minimum charge per meter per month. 1.00

CITY OF JAMESTOWN, N. Y. MUNICIPAL ELECTRIC SYSTEM

Year 1933 Population Served: 52,276

Revenue\$764,265.06

Expenses:

Production	\$271,179.03	
Distribution	35,260.62	
Utilization	10,553.34	
Commercial	20,733.62	
General	20,436.92	358,163.53

Net Operating Profit **\$406,101.53**

Depreciation	259,316.91	
Interest	10,684.09	
Taxes	4,500.03	274,501.03

Net Profit **\$131,600.50**

RATES

Light, Heat and Power

			James-town	Sub-urban
First	50 K.W.H. per mo. per	K.W.H.	3.5 c	4. c
Next	50 K.W.H. per mo. per	K.W.H.	3. c	3.25c
Next	900 K.W.H. per mo. per	K.W.H.	2.25c	2.5 c
Next	10,000 K.W.H. per mo. per	K.W.H.	1.8 c	2. c
Next	20,000 K.W.H. per mo. per	K.W.H.	1.5 c	1.6 c
Next	50,000 K.W.H. per mo. per	K.W.H.	1.1 c	1.2 c
Excess	K.W.H. per mo. per	K.W.H.	.9 c	1. c

Minimum Charge—Jamestown:

\$0.70 net per month for 2 K.W. or fraction thereof of service capacity.
\$0.35 net per month per K.W. for all service capacity in excess of 2 K.W.

Minimum Charge—Suburban Territory:

\$0.80 net per month for 2 K.W. or fraction thereof of service capacity.
\$0.40 net per month per K.W. for all service capacity in excess of 2 K.W.

Terms of Payment: Net Cash. Five percent added if bills are not paid on or before the tenth of the month that they are due.

Jamestown, N. Y., Operates Efficient Light Plant Profitably

IN 1890 the Municipal Electric System of Jamestown, N. Y., was created by the taxpayers' authorization of a \$30,000 bond issue. In 1933 the plant was estimated to be worth \$2,200,769 (after deducting \$1,380,152 for depreciation) while the liabilities were but \$161,469 (including \$120,000 bonded debt); it was furnishing current to two neighboring villages and part of a township in addition to its own citizens; had a revenue of \$764,265, and expenses (including depreciation, interest and taxes) of \$632,665, and a balance at the close of the year of \$2,420,506. The operating profit was \$406,102.

During that year the plant delivered 38,414,452 kwh, of which 11,837,774 was metered industrial; 8,611,481 was metered residential, 8,016,857 was metered commercial; 2,715,677 was furnished to the city for lighting streets and municipal buildings, for municipal power and other purposes; the balance to railroads, by flat rates and lost and unaccounted for.

There were 13,415 residential meters in service, in communities having a total population of 52,276—less than four persons per meter, so they must have served practically every residence.

During 39 of the 41 years of its operation the municipal plant was competing with a private plant, which also was growing and placed a value of \$100,000 on its plant in 1897, when the city considered buying it; but it was not until 1931 that the city purchased the property and distribution system of the private company in the city of Jamestown, villages of Celoron and Falconer and part of Ellicott township.

In 1906 control of the plant passed from the Common Council to a commission, which in 1914 was combined with the water commissioners to form the Board of Water and Lighting Commissioners, which started a campaign for new business. In 1923 this board was suc-

ceeded by the Board of Public Utilities, which still operates it.

During 1917-1919, in spite of rising prices, the rates for current were not increased, and following the war the capacity had to be increased, and later the rates were lowered. The latter was objected to by the private competitor, which appealed to the Public Service Commission to compel the municipal plant to restore the previous rates. This suit was still in the courts when the city bought the private plant.

Said the Board of Public Utilities in its latest report: "The successful accomplishments of the city of Jamestown in the field of public utility operation have been due to the facts that the management of such systems have been entirely free from political interference, control or dominance in any form whatsoever and to the application of sound business principles by unselfish men who devote their time, efforts and ability to this community enterprise," most of them manufacturers, engineers and business men.

The 1933 balance sheet (consolidated with construction accounts) follows:

ASSETS		1932	1933
Fixed Assets	\$3,521,727.36		\$3,580,921.77
Less Reserve for Depreciation..	1,142,070.35		1,380,152.55
Net Fixed Assets	\$2,379,657.01		\$2,200,769.22
Cash	101,380.31		24,526.59
Loans to City			263,096.07
Other Current Assets	162,719.44		163,858.66
Deferred Charges	3,889.57		4,732.42
Total Assets	\$2,647,646.33		\$2,656,982.96
LIABILITIES			
Bonded Debt	\$ 133,000.00		\$ 120,000.00
Other Long Term Debt (Niagara Co. Contract)	100,000.00		
Current Liabilities	51,463.66		41,469.24
Special Reserves	88,007.82		75,007.82
Surplus (Re-invested in Plant)....	2,275,174.85		2,420,505.90
Total Liabilities	\$2,647,646.33		\$2,656,982.96

Have You Heard?

Norwalk, Ohio, Light Plant Shows Steady Gain

The Norwalk, Ohio, Municipal Light Plant had the greatest output in kw in the history of the plant in August, 1934. According to M. G. Irvin, Superintendent, every month in 1934 has shown an increase over the same month in any previous year, showing that the depression is not known as far as his plant is concerned. At the present time they are furnishing 618 street lights, for which the charges should be \$12,000.00 a year, and have been rebating the charge to the city for the past three years. In addition to that they have increased their payroll 30% which acts as a help to the relief agency in Norwalk. It has been possible to put all the extra help to work doing essential jobs.

Emergency Water Supply at Bridgeton, N. J.

A flood so damaged the Bridgeton, N. J., water works system last August as to necessitate resort to two artesian wells owned by the Fairbanks Morse Co., which have a combined yield of about 1.5 m.g.d., while the normal demand of the city is 4 m.g.d.

Water from well No. 1 was pumped into an aerating unit and then flowed by gravity into the clear well of the water purification plant, and from this was pumped into the distribution system. In the operation of the water works system, chlorine was applied to the water in the clear well just before entering the suction pipes.

Unfortunately, the flood had filled the clear well with polluted water, which was pumped into the distribution system mixed with the well water. As soon as possible the chlorine dosage was increased to 15 pounds a day, the system flushed out, and a general alarm broadcast to boil all drinking water. But this supply was inadequate, and necessitated a shut-down of tomato canneries and other industries and was insufficient for fire protection. To meet the emergency, water was drawn from the Cohansey Creek, in the city, which is polluted with industrial waste and sewage. As the water works pumps were inoperative, temporary pumps were installed on pontoons, operated by overhead wires, by which the creek water was pumped into the coagulation basin; after which it was filtered and subjected to such an excessive chlorine dosage as to be unpalatable, but it was rendered safe and aided in sterilizing the polluted mains. Phenolic tastes developed and activated carbon was used to remove them.

About a month after the flood, the plant was able to supply water from the original upland source, the treatment of which consisted of prechlorination, coagulation, ammoniation, filtration and post-chlorination.

Field Determination of Ammonia in Water Supplies

During recent years the use of ammonia in connection with chlorine in the treatment of water supplies and swimming pools has increased. Since, in order to provide adequate sterilization with these chemicals it is essential that the proportions of the two be held within rather narrow limits, a control of the amounts of

the chemicals used is necessary. The orthotolidine test is available to determine the amount of chlorine present, but a similar rapid and accurate field test for ammonia is desirable.

The Rochelle salt modification of the direct Nesslerization method for the determination of free ammonia has been adapted for such a field test and is described in a recent publication of the Division of Laboratories and Research Permanent standards, permitting the test to be carried out in convenient, two-ounce, French square bottles, have been developed. The accuracy of this method has been determined in the presence of color and turbidity and found to be well within the limits required for such estimations of ammonia.

Light-O-Graphs Simplify Illumination Tests

A simple new device for determining lighting intensities is known as the Westinghouse Light-O-Graph and consists of a piece of extremely sensitive photographic paper enclosed in a light-proof envelope. The envelope is colored to a very definite shade and has ten round apertures through which the sensitive paper is exposed to the light. The sensitive paper, before exposed, is of a light yellow color. As it is exposed to light it turns darker. In 2½ minutes, under the proper lighting intensity, the sensitive paper will turn a shade as dark, or darker, than the color printed on the protecting envelope. If, however, in 2½ minutes the sensitive paper is lighter than the protecting envelope, then the lighting is not of sufficient intensity. The editor will be glad to assist managers of municipal lighting plants to obtain a supply of lightographs.

Water-Softening Plant Installed at Utica

The residents of a part of the southern section of the city of Utica, N. Y., are now being furnished with softened water as a result of the recent installation of a plant of the zeolite type by the Consolidated Water Company which owns the municipal system. The rest of the city has been supplied for many years with water from Hinckley reservoir, known as the northern supply, which is naturally soft.

The new installation is the first company-owned, water-softening system to be operated in the State. Municipally owned plants have been authorized for construction at Delmar and East Rochester.

Joint Operation of Water and Light

(Continued from Page 52)

for production, \$8,470 for distribution, \$8,816 for commercial office expense, \$878 for new business expense and \$1,431 general; a total of \$56,384, leaving a net operating income of \$64,560.

The cost of current for the year ending Sept. 1, 1934, was 7.3 mills at the switchboard; depreciation at 4% would add 3.7 mills; distribution costs 1.5 mills; office expenses 2.2 mills.

The Street Light Department had a revenue of \$17,888 from the public treasury, \$429 from railroads for crossing lights and \$48 public utility tax. The operation and maintenance expenses totaled \$20,982; leaving a deficit of \$2,617 which was charged to the surplus on hand.

Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

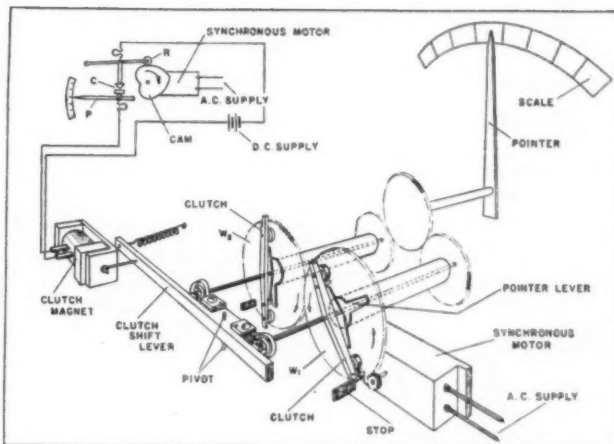
The Water Wheel

PUMPING costs of different types of plants, including in the cost fixed charges (including stand-by equipment) labor and fuel or energy, with coal at \$2.50 per ton in the bin, Diesel fuel oil at 4 c. per gal. in the tank, and electricity at 1.5 c. per k.w.h., are calculated by L. C. Price, from which, comparing steam turbine, Diesel, gas and electric plants, for 900 h.p., 200 h.p., 120 h.p., 60 h.p. and 10 h.p. plants, from which he concludes that, although much depends on local conditions, choice of the number and size of pumping units, price of fuel, etc., "electric power will probably be most economical in very small plants, internal combustion engines in the medium sized ones, and steam in the very large ones. Just where the dividing lines come in any one case is impossible to say. The cost figures for internal combustion engines are quite close together and very small items may decide the choice between Diesel, semi-Diesel, or gas engines." ^{F12-2}

Telemetering—the electrical transmission of gauge and meter readings—has been developed chiefly within the past ten years. There are four or more separate and distinct types of telemetering apparatus and 15 or 20 manufacturers of it. The 4 types are: 1—"Step-by-step" type. 2—Induction or "position" type. 3—Time impulse type. 4—Current type and voltage type. No. 1 consists of a transmitter which momentarily closes an electrical circuit once for each fixed interval of change in the measured quantity—one of two circuits for increase and the other for decrease; which closures act through a ratchet-like device to operate an indicator. No. 2 consists of armatures or coils at the transmitting and receiving ends which operate in magnetic fields and in a similar manner, the motion of the receiving armature being indicated or registered. No. 3 consists in closing an electrical circuit for a time which is proportional to the quantity being measured. No. 4 uses either variation of current flow or variation of voltage as a translating means; which have seldom been used for water works installations. Telemetering of all four kinds is based upon motion of some kind—a float, stem of a gate valve, etc. ^{A12-11}

In some types of telemetering not included above there is sending equipment only, the regular telephone service being used for the transmission of return signals. The automatic pumping stations at Baltimore are equipped with this type, which transmit, by long and short buzes, information about the pumps, reservoir level, and discharge pressure. ^{A12-10}

Underground leakage in New York City is located most effectively by use of the aquaphone. Enough has been located and stopped to offset the annual increase in consumption and so postpone large expenditure for additional supply; the cost of the leakage survey being but a small fraction of the value of the water saved and a fraction of 1% of the interest and sinking fund charges of the postponed expenditure for additional



Time Impulse Type Telemeter

supply. Results in New York suggest that under more adverse subsurface conditions of other cities, the method may be used to stop non-evident leakage at a cost well below the value of the water saved. New York has four crews continuously employed on leak location; Chicago maintains 12 such crews, which rely chiefly on the aquaphone, but the dye method has been used on about 50 miles of mains. ^{A12-7}

The Pittsburgh Suburban Water Service Co. uses a 2" current meter as a bypass around a gate on a supply main—preferably an outlet to a storage tank or reservoir—and the gate is closed between 2 and 4 a. m. and reading taken at 2-minute intervals until a minimum rate is repeated a number of times. If this minimum is unduly large, the system is subdivided into approximate halves and each tested, and this subdividing repeated until the excess loss of water is approximately located. Then leaks are located by sound devices. Meter readers are given bonuses for leaks discovered. ^{AA12-1}

Corrosion of pipes has been prevented by cement lining more effectively than by any other method yet devised; coal-tar coatings merely delay corrosion. Lime treatment is the most effective and economical method of corrosion prevention. If the pH value of a water is maintained at the point of solubility equilibrium of calcium carbonate or slightly above, an impervious coating of calcium carbonate will be formed in the distribution system; the treatment must be continued, as the natural soft water would dissolve this thin coating. When the alkalinity of the water is below 25 ppm., not so much protection can be expected from lime treatment as with water with higher alkalinity. For soft waters, a pH value of about 9.0 is required for the formation of the coating. Formation of the coating requires continuous contact with fresh supplies of water; it is practically impossible to prevent corrosion in dead ends by any known method of water supply treatment. ^{B11-10}

Odor removal at Ossining, N. Y., is effected by pre-aeration through spray nozzles, activated carbon and ammonia-chlorine treatment. Pre-aeration was omitted for a time but the net cost increased from 83 cts per mg to \$1.65. The aerator also smooths out the peaks in the odor load. With pre-aeration, 15 lbs. of carbon was used at 6 c. per lb., 7 lb. of chlorine at 5½ c. and 2¾ lb. of ammonium sulphate at 7 c.; while without pre-aeration it was necessary to use 25 lb. of carbon and 11 lb. of chlorine. Use of the carbon reduced the necessary alum dose by 40 lb., a saving of 64 c. "In addition to the removal of odors, the settled floc in the coagulation basin is stabilized by the carbon and there is less likelihood of obtaining a pin point floc during the winter months when the temperature of the water is low. Ammonium sulphate, in addition to preventing odors, helps to eliminate red water trouble."^{F12-1}

Electricity causes tastes and odors in water services, claims M. W. Cowles, saying: "The observations made in the field and laboratory investigations thus far tend to further confirm the theory advanced that stray alternating and direct currents on water service pipes do apparently have deleterious effect on the water delivered through such pipes. Many water services and water piping systems carry currents and the magnitude of the currents is very surprising." This study originated with complaints of consumers of the Hackensack (N. J.) Water Co., of "peculiar metallic or astringent tastes, odors and discoloration." Electric current, either alternating or direct, was found on the services wherever this was reported; rising to 5 to 12 amperes of a. c. at night. The removal of the current is followed by a sharp reduction in the odor and a gradual reduction in the taste. Chemical analysis indicated no increase in zinc, alkalinity, sulphates, nitrates, chlorides, etc.; but it is possible that there may be a change beyond the limits of precision of analytical methods now available. No satisfactory theory of the cause of the phenomenon has been presented.^{B11-11}

Verdunization (so named by Bunau-Varilla because discovered by him on the Verdun battle field) claims to secure sterilization by the use of much less chlorine than the "chlorine demand" of the water, immediately and vigorously mixed with the water. Lyons, France, uses only .05 ppm. of chlorine, Dieppe .02 ppm. Dozens of others in France and Belgium, 0.1 ppm. Bunau-Varilla describes the action as follows: "The destruction of the major part of the infectious bacteria is effected by ultra-violet rays emitted by the chemical reaction resulting from the contact between the organic matter of the water and the particles of chlorine distributed in the whole mass of water by the violent agitation to which it is submitted. The rest of these bacteria are destroyed by direct contact between them and the particles of chlorine which they happen to meet."^{A12-12}

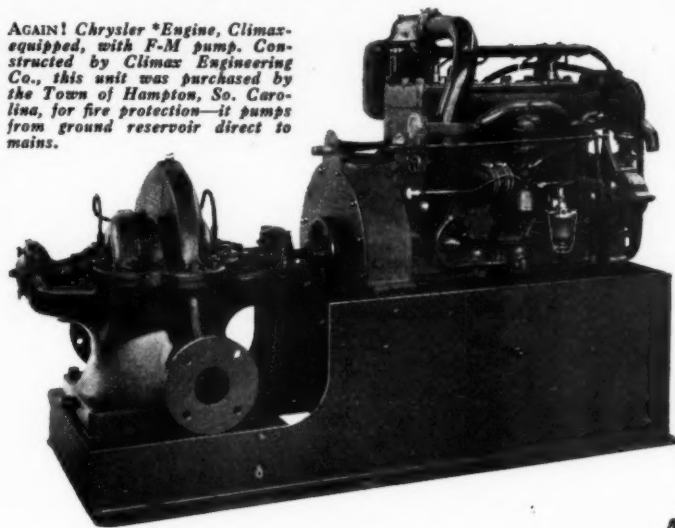
Bibliography of Recent Water Works Literature

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of *Public Works* in which the article was listed, which is generally the current but may be a previous one.

- A** *Journal, American Water Works Association*
12 *October*
1. Pipe Corrosion Experiments, Catskill Supply, New York City. By Frank E. Hale, pp. 1,315-1,347.
 2. Direct Purchase of Materials for Construction Contracts vs. Purchase Through Contractor. By Paul Hansen, pp. 1,374-1,381.
 3. New Questions of Law and Policy in the Making of Rates for Water Service. By William L. Ransom, pp. 1,382-1,385.
 4. Recent Tendencies in Relation to Valuation of Water Rights. By Robert E. Horton, pp. 1,386-1,413.
 5. Outstanding Factors in Underground Water Waste Surveys. By Fred B. Nelson, pp. 1,414-1,433.

6. Thawing Frozen Service Pipes. By Reeves J. Newsom, pp. 1,434-1,449.
 7. Milwaukee's Water Purification Problem. By Joseph P. Schwada, pp. 1,450-1,491.
 8. Automatic Pumping Equipment and the Telephonic Supervisory System in Baltimore. By Leon Small, pp. 1,492-1,506.
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1. Some Studies on Water Purification. By A. H. Waddington, pp. 377-379.
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12 *November 2*
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 2. f. Power Unit Costs for Pumping. By L. C. Price, pp. 1,208-1,211.
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 4. Automatic Control Aids Pumping Station Efficiency. By James F. Conlan, pp. 1212-1213.
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 6. Problems in Thawing Frozen Water Pipes in New York State. By C. A. Holmquist and A. F. Dappert, pp. 1226-1227.
- November 14**
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7. Water and the Goiter Problem. By Nathan N. Wolpert, pp. 1260-1263.
 8. Elements of Coagulation. By Geo. D. Norcom, pp. 1264-1267.
- G** *Water Works and Sewerage*
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1. Advertising the Water Supply. By W. L. Eisert, pp. 363-368.
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- J** *American City*
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1. Thawing New York State Water Mains. By C. A. Holmquist and A. F. Dappert, pp. 53-54.
 2. Water Rates and Service Charges, pp. 75, 77, 79, 81, 83.
- K** *Proceedings, Am. Soc. of Civil Engineers*
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1. The Springwells Filtration Plant, Detroit, Mich. By Eugene A. Hardin, pp. 1289-1327.
 2. f. Flow of Water Around Bends in Pipes. Discussions by D. B. Gumensky, W. M. Lansford and F. T. Mavis, pp. 1388-1397.
- L** *Civil Engineering*
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1. f. Analytical Approach to Experimental Hydraulics. Dimensionless Numbers. By Hunter Rouse. Dimensional Analysis in Model Studies. By Ralph W. Powell, pp. 563-571.
- P** *Public Works*
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1. n. Saving Meters from Hot Water Troubles, p. 16.
 2. Studies in Water Consumption: South Atlantic States, p. 23.
 3. Coagulants Used in Water Purification. By L. L. Hedgepeth, p. 31.
 4. Jacksonville's Municipal Water and Light Plants. By O. Z. Tyler, pp. 35-37.
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 2. Controlled Coagulation Maintains Filters in Good Condition. By Frank W. Bouson, pp. 15-16.
 3. Inexpensive Ammonia Treatment. By B. H. Brock, pp. 17-18.
 4. On Softening. By John Brunner, pp. 18-20.
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 6. Cogitations of a Neophyte. By R. H. Crone, pp. 22-27.
 7. Troubles with Open Reservoirs. By James G. Griffiths, pp. 31-33.
 8. Operation of Filter Plant at Pottstown Before and After New Sedimentation Facilities Were Installed. By E. K. Grubb, pp. 33-38.
 9. Characteristics of Wells in Limestone Formations. By E. L. Kershaw, pp. 38-40.
 10. Tadpole-Infested Reservoir. By P. R. Lutton, pp. 40-42.
 11. Iron and Acid Troubles. By H. W. Pharaoh, pp. 42-45.
 12. Elements of Coagulation. By George D. Norcom, pp. 49-59.
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 14. Some First Year Operating Experiences at Easton, Pa. By R. W. Haywood, pp. 68-80.
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 16. Laboratory Control of New York City Water Supplies. By Frank E. Hale, pp. 89-119.
 17. Odors and Tastes in Water Supplies and Methods for Their Determination. By M. Warren Cowles, pp. 120-131.
 18. Metering and Meter Maintenance. By Guy Morrow, pp. 132-138.
 19. The Frost. By D. J. McGeehin, pp. 139-146.
 20. Wasted Water. By H. E. Beckwith, pp. 147-153.
 21. The Length of Filter Run with Pennsylvania Anthracite. By H. G. Turner and G. S. Scott, pp. 154-170.

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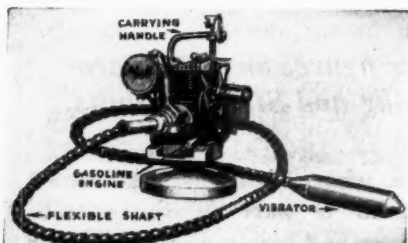
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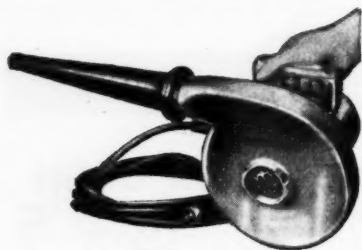


Koehring 7-S Mixer

Strength has not been sacrificed. Other features are, the automatic skip-flow shaker; anti-friction bearing and full spring mounting.

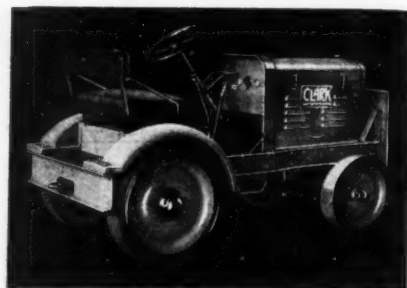
Further details can be obtained from Koehring Co., 30th Street and Concordia Ave., Milwaukee, Wis.

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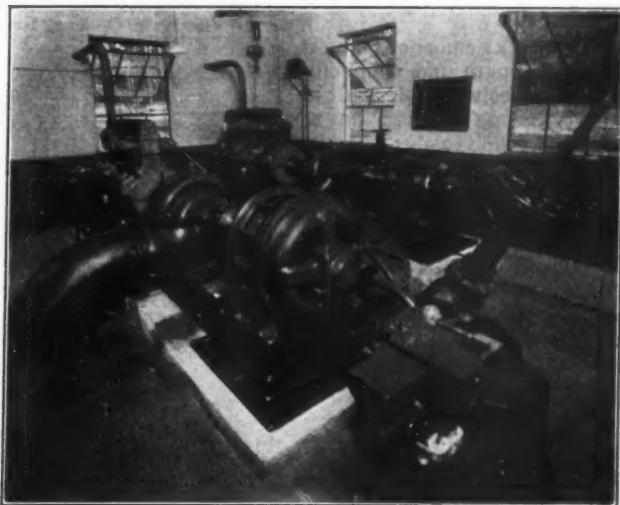
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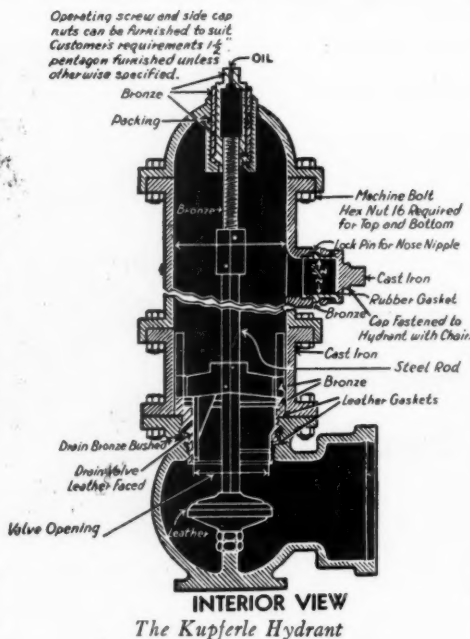
This hydrant has a number of features, in addition to strength and simplicity. The head can be revolved as desired; all working parts can be removed for replacement or inspection easily; extension pieces are available to enable the user to change the depth of bury; if the barrel is broken, the hydrant shuts off automatically. It conforms to the specifications of the AWWA. All moving parts are of manganese bronze with a tensile strength of upward of 50,000 pounds. Made in various sizes. Write the John C. Kupferle Foundry Co., St. Louis, Mo., for further details.

Truscon I-Grid Bridge Floor Construction:

I-Grid is an improved armored surfaced slab combining all the advantages of ordinary reinforced slabs and in addition having the advantage of extreme lightness in weight, a surface of steel and concrete in diamond formation which is the ideal arrangement for gripping tires and preventing skidding, protecting the concrete from traffic wear thereby increasing its life and reducing the cost of repairs and wearing surface renewal.

Through the scientific distribution of steel, concrete cracks are avoided and wheel loads are given the widest distribution. Steel units are lighter in weight and more easily handled. Field welding is simple in arrangement and quickly done at the minimum cost. Concrete may be easily placed without having to use excessively fine aggregate. The exposed steel on the top surface is of sufficient width to insure reasonable contact with tires, at the same time presenting sufficient surface contact to make it a most excellent floor where heavy trucking is required. Heavy flanges give unusual stiffness before concrete is placed so that substantial loads can be safely applied during construction.

I-Grid slabs also form excellent warehouse, factory, pier and other floors sub-



ject to heavy trucking loads. Through its extremely light weight it is especially valuable for floors over bad foundation conditions. Its armored surface prevents trucking wear and provides a non-skid, permanent surface which will last indefinitely, eliminating the cost of a special, costly wearing surface and expensive maintenance to keep in good condition.

Grease Packed in Cartridges Now on the Market:

Greases packed in cartridge form to fit a new type of grease gun are now being sold by the Standard Oil Company (Indiana).

The cartridgeing of grease is a distinct innovation. To fill the new type of grease gun the operator merely slips a factory loaded cartridge into the barrel of the gun which is then ready for use.

The cartridges now being made are of one-pound capacity and include sev-

eral grades of lubricant. This method of handling works equally well with fluid gear lubricant or fairly stiff grease. A partially used cartridge can be quickly replaced with another cartridge of different grade of lubricant, and the lubricant in the used cartridge, being enclosed, is not wasted and does not accumulate dirt.

This new, more convenient lubrication system has been perfected during the past few years by the Lubrication Corporation, Chicago, a concern owned jointly by the Standard Oil Company of Indiana and Bendix Aviation Corporation. Each cartridge has a sliding bottom which acts as a plunger to feed the lubricant into the high pressure chamber in the nose of the gun. Although the cartridges cannot be refilled, they cost only slightly more than the same amount of grease packed in ordinary containers.

Compressors:

Schramm, Inc., West Chester, Pa., has issued a 12-page catalog on belt and motor driven compressors, which gives complete details, specifications, dimensions, capacities, etc. Sent on request.

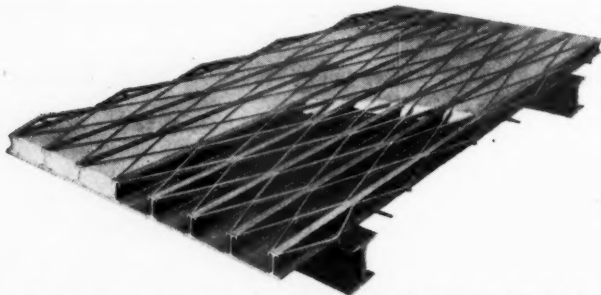
New Austin-Western Roll Crusher:

A new reduction roll crusher, built primarily to produce material from 1½" down to dust (though it will handle larger sizes) has been announced by the Austin-Western Road Machinery Company of Aurora, Illinois. According to the manufacturers, it requires less power and since it operates faster (60 R. P. M.) its capacity is therefore greater.

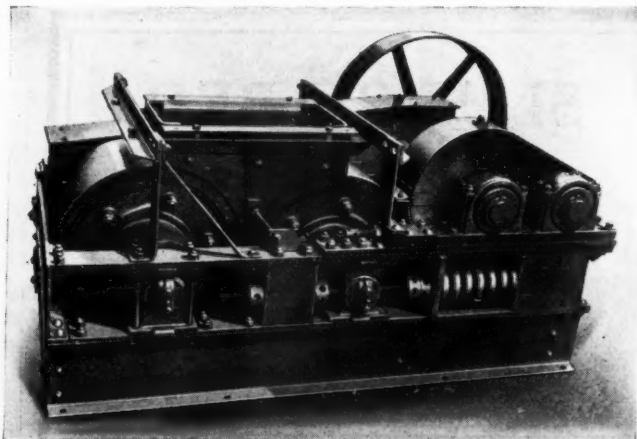
The rolls measure 18" wide by 30" in diameter and are equipped with 2" thick, removable, manganese shells. Each roll is supported by two, large SKF, self-aligning, roller bearings, that rotate on heavy stationary shafts. These bearings are located inside the rolls close to the outer shaft supports to materially reduce shaft load.

Two screws (heavy-spring equipped) permit any desired adjustment of rolls and act as safety releases against tramp iron or other uncrushable material.

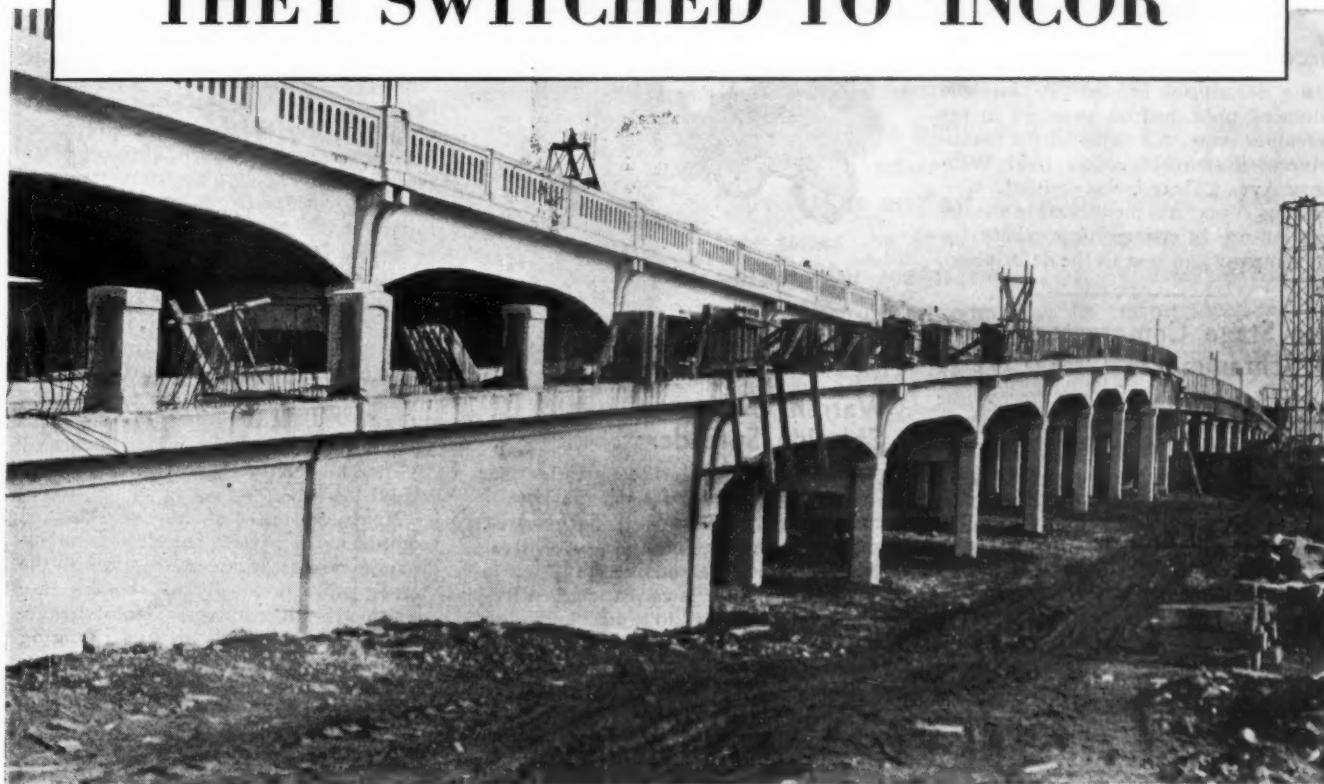
Gearing, sprockets and chain are fully enclosed with heavy metal guards —Alemite lubrication is used.



Above, an illustration of the Truscon bridge floor grid. At the right, the new Austin-Western roll crusher.



TO SPEED UP WINTER WORK THEY SWITCHED TO 'INCOR'



***Result,—Heating Costs Reduced; Frost Hazard
Greatly Lessened; Opened 2 Months Sooner***

To simplify Winter construction problems, many contractors have switched to 'Incor' on work in progress. Here is a case in point:

On State Highway 29, near Newark, N. J., an important super-highway viaduct, 1800 ft. long, consists of 30 concrete-beam spans and 9 steel-girder spans. As cold weather came on, 'Incor' Cement was used on the last four steel-girder spans.

Forms Stripped 11 Days Sooner

With 'Incor', forms were stripped in 3 days instead of 14—saving 11 days on each of four spans. Without building additional forms, contractor completed job two months sooner.

Tarpaulins over the deck slab retained concrete's heat; wood-burning salamanders under the span, and tarpaulins

hung on windward side to shut off draught, protected concrete during the important 48-hour curing period following placement. By using 'Incor', the contractor also obtained more workable concrete with a lower water content, facilitating placement by towers and chutes.

Write for New 'Winter' Book

A new book on "Winter Construction" is now ready; it contains practical information on all types of Winter concreting. Address 'Incor' 24-Hour Cement, Room 2200, 342 Madison Ave., New York, for free copy. 'Incor'* is made and sold by producers of Lone Star Cement, subsidiaries of International Cement Corporation, New York; also sold by other leading cement manufacturers.

* Reg. U. S. Pat. Off.

'INCOR' 24-Hour Cement

When writing, we will appreciate your mentioning PUBLIC WORKS.

MORE NEW EQUIPMENT

Barco Gasolene Hammer:

In a description headed "A Gasolene Hammer" published on page 50 in the November issue, the name of the manufacturer—Barco Mfg. Co., 1801 Winemac Ave., Chicago, was omitted.

Evans Associates mentioned in the description are in charge of publicity for that company and sent us the description.

Two Stage Compressors By Schramm:

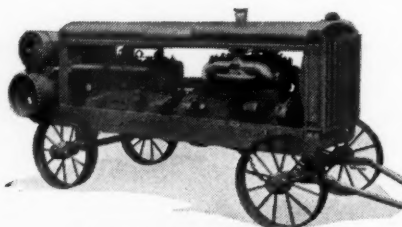
Schramm, Inc. has announced the addition of a complete line of two-stage portable compressors.

The one outstanding characteristic of the two-stage outfit is the fact that many parts are interchangeable with the single-stage compressor permitting the user to utilize many of the parts which he may already have on hand for servicing the new design.

The greatest efficiency has been secured by piping air from the first stage through a cross-flow type inter-cooler into the second stage which gives the air the final compression before entering the air receiver.

These compressors are built in four sizes (Models 105, 160, 210 and 315) with either gasoline or Diesel engine drive, and are available in all types of portable mountings, including wooden skid mounting, steel wheels, rubber tired wheels, Schramm Spring Trailer, two wheel trailer, motor truck mounting, rail car mounting, etc.

A new bulletin 3501 (CS) describing



Schramm 2-Stage Compressor

the new two-stage compressor is available by writing to Schramm, Inc., West Chester, Pa.

Warren Calcium Chloride Spreader:

This calcium chloride spreader is a unit built especially for the purpose of making applications over large areas and providing uniform measured treatment at a most reasonable cost.

The distributor is constructed entirely of metal and painted to protect and afford lasting service, but it should be washed after using to dissolve any chloride. A brief description: Rigid all metal construction; spreads full 6 ft. Hangs close to the road. Holds four bags Calcium Chloride. All the weight of the machine and contents are on the wheels, not the workman. The two front wheels can be adjusted to any parts on the shaft. This permits using the machine very readily on curb construction where the hopper has to overhang. Will scatter very uniformly without showing streaks as the machine is equipped with drag bar for that purpose. One man can operate very handily. Weight 250 lbs. Can be



Warren Calcium Chloride Spreader

equipped with either steel or pneumatic rubber-tired wheels. Meets State and Federal specifications for spreading Calcium Chloride. Manufactured by the Salem Tool Company, Salem, Ohio.

For Deep Well Pumps:

The U. S. vertical unclosed motor is a motor developed to meet the particular requirements for the turbine pump industry. It can be safely exposed to hard conditions, for the interior operating parts are shielded and protected against abrasive elements, dirt or dripping water. The electrical windings are insulated with asbestos specially treated to render it non-hygroscopic.

The adjustable hollow shaft gives to the pump industry a means for conveniently adjusting and setting the runners of a deep well pump and at the same time removes the need for a flexible coupling between the motor and the pump.

Only ballbearings are used and the complete thrust of the pump is carried by an anti-friction type thrust bearing, oil-lubricated.

Non-reversing clutches are standard equipment to protect the unit from injury in case of accidental rotation in the wrong direction. These motors are equipped with a universal, interchangeable ring base which permits changing the motors of different horsepower ratings over a wide range of capacity without involving the expense of re-machining the pump head.

The rotor is die-cast aluminum, one piece, and is dynamically balanced to eliminate vibration since turbine pumps are most efficiently operated at high speeds which require perfect balance.

All castings are normalized to insure permanent alignment between motor and pump.

This motor is manufactured by the U. S. Electrical Mfg. Co., Los Angeles, Calif.



U. S. Motor for Deep Well Pumps

MUD-JACK METHOD



Corrects Sunken Street Slab —

as well as curb, gutter and walks. The No. 10 N. E. C. Mud-Jack raises sunken curb and gutter to the original or proper grade—and then raises the street slab to obtain a level surface. No replacement cost necessary—no street obstruction common to reconstruction activities—and above all, maintenance costs are reduced to a minimum.

Write for Mud-Jack Bulletin

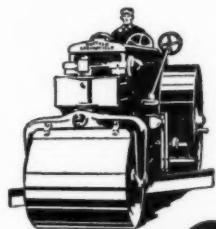
KOEHRING COMPANY

Milwaukee

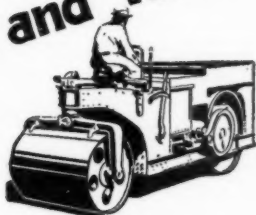


Wisconsin

For Raising Concrete Curb, Gutter, Walks, Street



BUFFALO-SPRINGFIELD
Three Wheel and Tandem



Buffalo-Springfield's complete range of models in both three-wheel and tandem rollers permits the purchaser to select the proper machines for his work.

Full details will be furnished on request.

THE BUFFALO-SPRINGFIELD ROLLER CO.
SPRINGFIELD, OHIO



THIS is Catalog No. 53

Did YOU Get a Copy?

If Not Send for It Now

Sludge Digestion in An English Plant

AN INTERESTING sludge digestion plant, that at Southall, England, was described and discussed at the November meeting of the Institute of Sewage Purification, and the paper (presented by Rowland Hall, manager and chemist of the plant) and the discussion by several members was printed by "The Surveyor," from which the following abstract has been prepared.

The sewage treated in this plant averages 1,900,000 British gallons per day, from a population of about 40,000, including about 100,000 g.p.d. of trade wastes from provision factories, dye works and others. The sludge is collected in precipitation tanks and from them removed to a storage tank and pumped into the digestion tanks. There are four of these, 26 ft. wide, octagonal in shape, 20 ft. 6 in. deep of which 8 ft. 3 in. is vertical and the bottom 12 ft. 3 in. shaped like an inverted pyramid.

The sludge enters through a 6 in. pipe 8 ft. 3 in. below the surface, horizontal in a tangential direction, thus setting up a slow whirling motion so that the incoming sludge is at once mixed with the partly digested sludge in the tank. After the fresh sludge is in the tank, air is generally blown into it through the outlet at the bottom of the hopper at 10 to 15 lb. pressure for two hours, giving a more thorough mixing and preventing the sludge in the bottom of the hopper from becoming too compact. "I run the liquid water off when necessary, not at any given period, and although the tanks mostly get the same character of sludge, it is rather surprising to find that the depth of water that can be drawn off alters considerably. This may be due to the directional position of the tank. I have found that the water will form in layers and the decanting tubes can deal with this very effectually. The greatest depth of water I have drawn off from one tank was 4 ft., and the least about 6 in.

"Each tank is supplied with a decanting tube made of a brass tube which fits vertically inside another brass tube. The outer tube has 6 in. slots to a depth of 4 ft. The inner tube also has 6 in. slots placed so that only one at a time can permit the waste liquor leaving the tank. They are in step fashion and cover the length of the tube which coincides with the outer tube; by this means it is an easy matter to arrive at the working condition of the tank at any depth in the vertical part of the tank. These decanting tubes have a special outlet into a separate manhole built on the outside of the tank in which is placed a small sluice valve. The decanting water is run down to an old gravel filter and thence to the river."

These decanting tubes also permit testing the liquid at any depth in the tank, and Mr. Hall has found that, by making these tests for pH (and others also, we understand) he obtains indication of the condition of the tanks, the tests showing quite clearly whether the tanks are digested sufficiently to be drawn off onto the drying beds. Sludge is drawn off about once a fortnight, and has a moisture content of about 94%.

The tanks are neither covered nor heated, and lack of this does not seem to be a disadvantage; possibly because of the depth of the tanks.

The digested sludge is drawn onto four sludge

drying beds each 82 ft. by 44 ft. giving a total area of 1604 sq. yd. for 40,000 people. The beds have earthen floors and banks, filled with a layer of fine ashes on 12 in. of coarse clinker, underdrained by parallel lines of 3 in. tile 2 ft. apart. The beds are not covered. Sludge with a pH of 7.3 drawn onto a bed to a depth of 8 in. had shrunk to 1.5 in. in eight days and "cracked up beautifully." Recently 9 in. of sludge had on the 5th day shrunk to $4\frac{3}{4}$ in. when rain fell and there was still $3\frac{3}{4}$ in. on the 10th day and the sludge started to crack. It rained again on the 11th and 15th days, but by the latter day the sludge was only 2 in. and could be shoveled.

During operation, 1,029,932 gallons of wet sludge has been put in the digestion tanks, 399,064 gal. of water has been drawn off by decanting tubes, and 305,492 gal. of sludge have been drawn from the digestion tanks.

The Ministry of Health usually requires 3 cu. ft. of tank per head of population, but these tanks have been running very successfully since the summer of 1932 with a capacity of 0.55 cu. ft. per head. The Ministry also requires one square yard of drying bed for seven people, while these beds give one square yard to 25 people.

The digestion tanks cost \$8,750, the sludge-drying beds \$3,400, and the sludge pump and piping \$2,530; a total of \$14,680, or \$0.37 per capita. The cost of operating the plant is less than 50% of that of sludge pressing, which it replaced.

During the discussion, W. Hughes of Chingford stated that when his sludge had dried from 9 in. to 2 in. he put on a further dose, which drained through the cracks in the first, and when this had dried he put on a third dose, and removed the dried sludge from all three with one shoveling. Sludge once dried never returned to its former condition when wet by more sludge or by rain. However, W. F. A. Snook, of Epsom, had tried this double dosing and found that the second layer took three times as long to dry as the first layer, and when removed was found to be full of maggots.

Gas produced by digestion is not collected at Southall, and R. Hicks, of Gravesend stated the opinion that the desirability of collection was dependent upon the use that could be made of the gas produced. At Gravesend they obtained the unusual amount of 1 cu. ft. per capita per day, or 40,000 cu. ft. but used only enough to create 14 to 15 horsepower—not sufficient to give a proper return on the money spent in covering the tanks.

Rapid Determination of Turbidity and Suspended Solids in Sewage

An investigation is being conducted by Glenn W. Holmes, of Syracuse (son of Glenn D. Holmes, who has done such excellent work as chief engineer for over twenty years of the Syracuse Intercepting Sewer Board), for the purpose of ascertaining if it would be possible to develop a procedure by which the suspended solids (ppm) in sewage can be determined quickly and in close agreement with the standard Gooch crucible method. This crucible method requires several hours for filtering, weighing and drying, and it is hoped to develop a method which would require only as many minutes.

Such a method, if found practicable, will be of great assistance, particularly in the control of activated sludge and chemical treatment plants, permitting more efficient



Use of "Transometer" for determining turbidity

and economical operation of them. Investigations by others with this object in view have included the use of hydrometers, centrifuges, turbidimeters, chemical reagents, etc., but with little success. Mr. Holmes has been experimenting with the use of a "Transometer," a Westinghouse photoelectric apparatus for measuring transparency. There is no question that turbidity can be measured satisfactorily by this apparatus, and data collected in working with several types of local sewage seem to indicate that it will meet the needs for rapid quantitative determination of suspended solids. Before announcing definite conclusions, however, the results will be checked with the sewages of several other cities.

In using the Transometer for measuring turbidity, the sample to be studied is placed between the light source and the photox (a light-sensitive cell). The amount of transmitted light is indicated in percentage on the instrument dial, which percentage can be translated into turbidity. Or, presumably, a special dial could be used which would give the turbidity figures directly.

Sewer Rentals in Bloomington, Ind.

Among the states which recently have passed laws permitting its cities and towns to charge for sewerage services as a method of financing the construction and operation of sewerage works is Indiana, which passed such a law at the 1932 special session of the General Assembly. Bloomington, a city of about 20,000 population, under this law borrowed \$495,000 from PWA, 20-year bonds for which sum will be carried and amortized by sewer rentals. The amount was used for building a sewage treatment plant, more than two miles of concrete interceptors and an outfall sewer approximately two miles long; also for enclosing in concrete tunnel the Jordan river within city limits.

An ordinance was passed providing a scale of charges, based on water consumption, as follows:

First 2,000 gals.	\$0.125 per 1,000 gals.
Next 3,000 gals.10 per 1,000 gals.
Next 5,000 gals.09 per 1,000 gals.
Next 10,000 gals.08 per 1,000 gals.
Next 30,000 gals.07 per 1,000 gals.
Next 50,000 gals.06 per 1,000 gals.
Next 100,000 gals.05 per 1,000 gals.
Next 150,000 gals.04 per 1,000 gals.
Next 250,000 gals.03 per 1,000 gals.
Over 600,000 gals.02 per 1,000 gals.

It is estimated that approximately 70 per cent of residential users will pay 45 cents or less per month, and 52 per cent will pay 35 cents or less per month. Of all sewer users, including residential, apartment house and commercial, approximately 75 per cent will pay 82 cents or less per month and 52 per cent of all users will pay 45 cents or less per month.

Ask for Specific Answers When Anyone Claims—

"Our pavements have longest
life and lowest upkeep costs."



Fair questions to ask all pavement salesmen

- 1 Name pavements of the type which you represent that are now in use after (a) 40 years; (b) 30 years; (c) 20 years.
- 2 Do you base any of your claims for long life and low maintenance on data obtained from accelerated tests?
- 3 How does the type of pavement which you represent rank in low maintenance costs in the non-accelerated tests now being carried on by the U. S. Bureau of Public Roads at Chevy Chase, Md.?
- 4 Is the surface of the pavement which you sponsor affected by weathering action in (a) absorption of water and freezing? (b) expansion and contraction? (c) chemical instability?

the street and highway records of America during the past 50 years. Use brick surfacing on new pavements. Resurface old, failing, pavements with brick.

For data, write the National Paving Brick Association, National Press Building, Washington, D. C.

BRICK PAVEMENTS

Exhibitors convention and exhibit American Road Builders Association, January 22-25, Washington, D. C.

Legal Liabilities of Swimming Pools

By John McGlasson, City Attorney, Waco, Texas

IN speaking of the liabilities of swimming pool owners, whether it be municipal or private, we get into a broad legal question. As long as there are no accidents or deaths at or caused by the pool, the owner should be happy and thankful. On the other hand when such accidents do occur, it is unfortunate for the pool owner because in almost every instance if there are not sufficient facts to justify calling for court action, the plaintiff will manufacture such facts and bring court action. Therefore, it is necessary that persons in charge at all times exercise utmost care and precaution, and provide every possible protection to the swimmers.

The City of San Antonio operates a number of swimming pools within the city limits. Some time ago a man living some 75 miles from the city drove over, according to his testimony, and went swimming in one of the municipally owned pools. About two months after the date on which he was supposed to have been in the pool, he filed a claim against the City of San Antonio for injuries received at the pool from a fall due to unsafe and faulty apparatus. Of course, an investigation was made but there was no possible way of proving that the man had been in the pool on that particular day nor that the apparatus was then defective, since at the time of the investigation the apparatus was in perfect condition. However, the city, realizing the usual action of a jury in such suits, settled the suit without court action for a small sum of money. In connection with this particular matter, it would almost be impossible to offset any claim made by any person against a swimming pool owner. This is one of the chief hazards that the municipal as well as the private pools must face. Therefore, it is most imperative that a pool either privately or municipally owned should be regularly inspected and records of the inspection kept as a protection to the owner.

Many of the accidents which occur at swimming pools are caused from diving. At almost all pools at the present time, signs have been erected notifying the patrons of the depth of the water and designating danger zones along the sides. Of course, all that a pool owner can do is to have such signs either erected on the side of the pool or painted on the walls and trust that his patrons will abide thereby. However, where accidents occur from diving into too shallow water the plaintiff will usually plea to the jury that the signs were covered, illegible, or erected in such a way that they could not be seen from where he dived into the water, and raise a question for the jury to decide.

Another hazard to the pool owners is infection. Infections are possible either from impurities in the water or from some swimmer who was in the pool. It would be rather difficult for a person to prove that an infection was caused from a certain swimming pool, but they will usually produce sufficient facts to get a jury question. The average jury is not controlled by what they think to be the facts but make up their minds as to which party they would like to recover and generally render their verdict accordingly.

One of the biggest hazards that the pool owner faces is drowning. Every pool should certainly provide a competent life guard and use every possible precaution against this possibility. When someone drowns in a pool

the question is immediately raised as to whether or not there were a sufficient number of lifeguards on duty and if they were thoroughly competent and qualified. Then, too, if the lifeguard is proven competent there is the question of negligence. The plaintiff can usually find at least one witness who will testify that at the time that the drowning occurred the lifeguard was not paying attention to the swimmers. When suit is brought, the pool operator is charged with maintaining a nuisance. Since the operation of swimming pools and parks is a governmental function, the city is not liable, but, if it is proved to be a nuisance, the city is liable for maintaining any kind of nuisance.

One of the greatest hazards for the pool owner is small children. In the case of municipally owned pools where the public is invited, it is impossible to fix any kind of age limit. Of course, it is possible to provide a wading pool for the smaller children, but if they happen to get into the deep water (for which the city is not to blame), nevertheless it is charged with negligence. Of course, in private pools it is possible to set an age limit and not allow the children under a certain year to go in swimming.

In conclusion, the pool operator is almost defenseless when one of these cases arises. About the only method of protection for the pool owner or operator is through insurance and in addition to provide as many safeguards as possible against all of the above stated hazards.

The above is based on remarks by Mr. McGlasson before the meeting of the Texas Beach and Pool Association, at Dallas, Texas.

When Competitive Bidding Is Not Advantageous

Water works materials such as fuel, chemicals, pipe, cement, etc., can be purchased to the best advantage by competitive bidding on standard specifications. But W. C. Hawley, general manager and chief engineer of the Pennsylvania Water Co., stated before the Pennsylvania Water Works Assn. his belief that many classes of materials can be purchased to better advantage by selecting articles that have been satisfactory in operation, are reasonable in first cost (but not necessarily the cheapest), of good design, and made by an experienced manufacturer of proven integrity and purchase them without competitive bidding. Such objects include gate valves, hydrants, meters, corporation and curb cocks.

Experience has shown that manufacturers of such articles, if relieved of cost of competition and given reasonable assurance that his goods will be purchased in the future if the quality and price are satisfactory, will make his prices substantially lower than those he would quote in competitive bidding.

In deciding on a choice of make, satisfaction and maintenance cost should be considered. When Mr. Hawley took charge of the plant of the Pennsylvania Water Company he found 20 kinds of water meters in use. Four of these were chosen as temporary standards, a record of cost of repairs kept and within a few years it became evident that it would be desirable to standardize on one make, which would reduce both original cost and cost of maintenance.

GEORGIA OPERATORS HOLD SHORT SCHOOL

Reported by Paul Weir

The third annual meeting of the Georgia Water Works Operators' Short School was held at Georgia School of Technology, Atlanta, Ga., November 8, 9 and 10, under the joint auspices of Georgia Tech and the State Board of Health, with 142 present. The school was opened with welcome addresses by Dr. M. L. Brittain, president of Georgia Tech, and Dr. T. F. Abercrombie, director of the Georgia State Board of Health.

W. H. Weir conducted a very interesting discussion on the "Mathematics of Practical Filter Plant Problems." The morning meeting was closed with a demonstrated lecture on "Elementary Chemistry" by Prof. Jno. L. Daniel. Prof. H. A. Wyckoff and N. M. deJarnette carried on group chemical and bacteriological laboratory experiments, simulating actual plant control tests at the afternoon session.

W. Zode Smith and W. M. Rapp conducted an inspection tour of the Atlanta filtration plants, explaining the various problems confronting them and how many have been solved.

The Georgia Water Works and Sewage Operators' Association held its first business meeting at a Banquet Thursday night. A Constitution and By-Laws were adopted, which required all members to pass an examination before Class "C" Water Plant Operators' Certificates could be issued. Class "B" and "A" Certificates will be subject to future examinations. The Association plans to instigate adequate legislation for licensing of all Operators in the future.

The following officers were elected for the ensuing year: President, Paul Weir; 1st Vice-President, Odell Gray; 2nd Vice-President, Carl Alexander; Secretary Treasurer, Lewis Simonton.

J. B. Carey and H. E. Whelchel were elected to the Executive Committee.

The Certification Board consists of the following: Professor H. A. Wyckoff, Professor Jno. L. Daniel, T. A. Jones, Lewis Simonton and Paul Weir.

Friday's session opened with a discussion on "Carbon Dioxide and Iron Removal in Well Water Supplies," by J. M. Kahn. H. F. Wiedeman enumerated the various ways water may be prepared for filtration. He said that the present trend of plant construction is toward the perfection and better arrangement of chemical appliances and mixing equipment. L. M. Fisher presented a paper on "The Danger of Cross-Connections." He emphasized the potential hazards involved and suggested a concerted movement for their elimination. Paul Weir suggested the adoption of a modified Standard Methods-Baylis procedure in the determination of Odors in drinking water, in his discussion on the "Measurement and Removal of Tastes and Odors."

The Certification Board of the operators' Association conducted an exam-

ination for all desiring Class "C" Certificates after the last afternoon session.

The evening meeting was devoted to a lively Round Table discussion of questions on individual plant problems and special subjects not otherwise covered in the course. The Question Box system employed was very effective in providing a variety of problems for general discussion.

L. M. Clarkson opened the Saturday morning session with a discussion on "Municipal Sanitation." He expressed the importance of general sanitation, especially to that portion of a town and its suburbs not sewered and supplied with city water.

H. P. Powell fully described the successful design and operation of a public swimming pool. This pool has been in service four summers and has a Class "A" rating. It is self-supporting and has never had a casualty. He recommended that all public swimming pools be placed under the supervision of the Water Department and subject to its rigid methods of control.

M. T. Singleton gave an illustrated talk on the "Methods of Sewage Treatment," including a description on the Imhoff and separate sludge digestion methods, as well as a description of the trickling filter process of oxidation and activated sludge treatment. He compared the sludge in this section to that of horse manure in fertilizer value.

The entire membership of the Short School expressed their appreciation to W. H. Weir, N. M. deJarnette, Professor H. A. Wyckoff, and Professor Jno. L. Daniel for the effort and time spent in preparing and conducting this successful school.

Incinerating Wet Refuse:

An apparatus for incinerating wet refuse of almost any degree of moisture with a maximum use of its heat units and therefore minimum use of additional fuel, without nuisance and in a minimum of space, is the aim of an invention of Irwin S. Osborn (patented Sept. 18, 1934 and assigned to the C. O. Bartlett & Snow Co.). In this, the garbage, sewage sludge, etc., is fed into revolving inclined drying cylinders, while hot gases from the incinerator pass through the cylinders in the same direction. By regulating the relative amount of hot gases and wet rubbish, the refuse is brought to 30% moisture content at the lower end. The hot gases being in contact with the wet sludge, and being cooled below scorching temperature before they reach the lower end where the 30% moisture is attained, there would seem to be no danger of odors from the dewatering. The 30% refuse is then fed to a pair of incinerator cells, which furnish the hot gases for drying. There are numerous details of construction calculated to move the refuse and gases through the plant as described and control all parts of the process to give maximum efficiency.

Material Prices

(Published for information only)

(Nov. 29, 1934)

Warehouse Prices on Reinforcing Steel and Structural Shapes

	Structural Shapes	New Billet Reinforcing Bars
New York	3.37c	2.82
Boston	3.52	—
St. Louis	3.44	—
Cincinnati	3.40	3.25
Pittsburgh	3.15	2.90
Chicago	3.20	2.10
Philadelphia	2.95	2.955
Cleveland	3.31	2.10*
San Francisco	3.55	3.50

*Plus extras

Prices on cast iron pipe, net per ton, Class B, 6-inch and larger, AWWA specifications*

Boston	\$47.50	Baltimore ...	\$45.50
New York ..	44.90	Atlanta	42.00
Chicago	46.00	Birmingham .	38.00
Minneapolis .	48.50	Kansas City .	48.15
Burlington, N. J.,	\$42.00; extra price for 4-inch, \$3.00 per ton; extra for Class A, \$3.00 per ton.		

*Information, courtesy U. S. Pipe & Foundry Co.

Warehouse Prices on American Pig Lead

Per pound

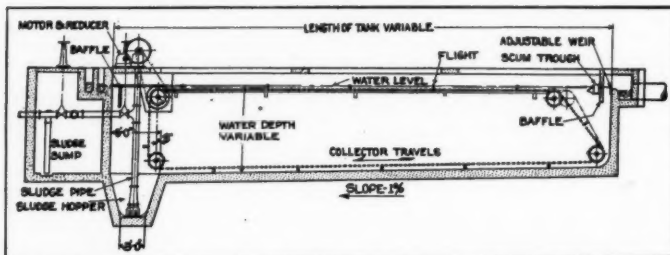
New York	4.37½ to 5.37½
Cleveland	4.50 to 4.75

F. Daly Sullivan, President of The Sullivan Company of Memphis, Tenn., manufacturers of Konset for concrete; Sealit, transparent waterproofing for walls; Kant-Leak for roofs; liquid, paste and powder waterproofing; Komix admixtures; metallic waterproofers and hardeners; plaster bond, foundation coating and stone backing; calking compound; acid-proof cements; shingle stains; structural steel, bridge and iron paint; aluminum paint; Kontite cement paint; X-It for termites; Penetrine, rust solvent and rust-proofing compounds; and other technical "Life Preservers for Buildings and Equipment," writes us that new and most modern machinery is being installed in the new factory at Memphis, Tenn., and that they expect to operate this at full capacity before the end of the year. They were forced to discontinue operations temporarily for a number of months owing to the dismantling of their old factory at Memphis to make room for one of the large CWA projects, the South Third Street Viaduct.

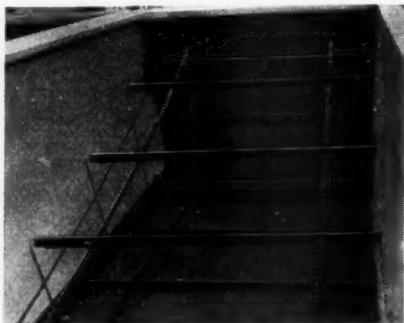
Centrifugal Blowers:

Single-stage centrifugal blowers and exhausters are described in bulletin 120-B10, just published by Roots-Connersville Blower Corp., Connersville, Ind. While the bulletin referred to covers only the single-stage units, the company also manufactures a complete line of multi-stage equipment. A table lists capacities up to 8,000 CFM at pressures up to 3 lbs., but information regarding larger capacities and higher pressures is readily available upon request.

LINK-BELT STRAIGHTLINE Sludge Collectors



Straightline collector as used in primary tank where top run serves also as a scum collector.



Straightline collector in final tank.

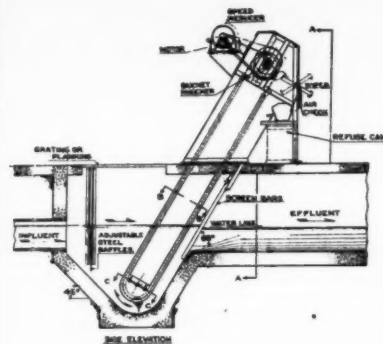
LINK-BELT COMPANY

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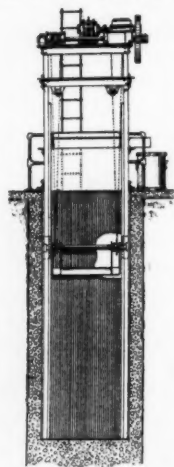
Adapted for continuous or intermittent operation, it fills a long felt want in the smaller size plants.

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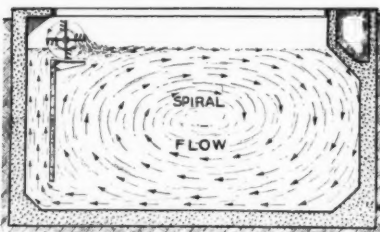
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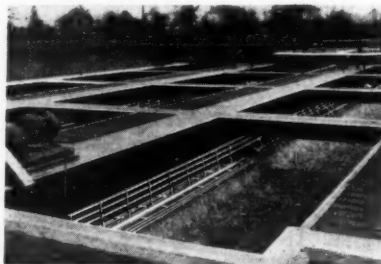
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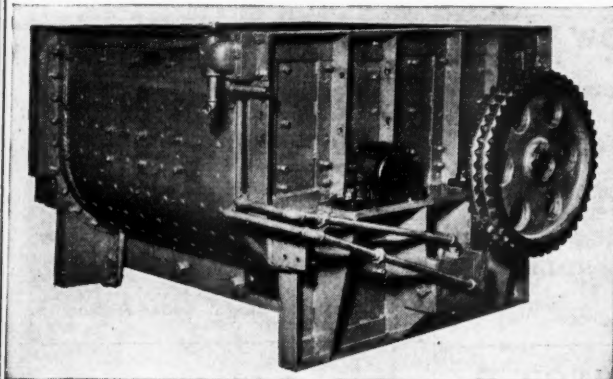
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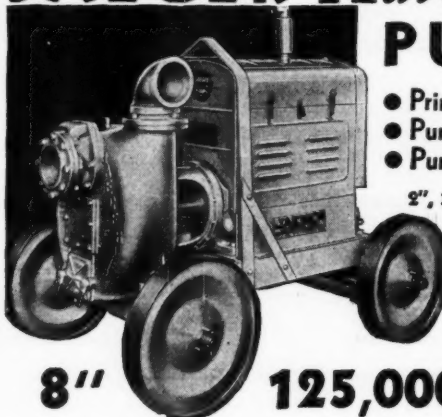
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Asphalt Heaters

9. Illustrated manual No. 11 describes "Hotstuf," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Bituminous Mixers: Locking Device

11. Time locking device for bituminous mixers, all mechanical, is described and illustrated in bulletin TL10 just prepared by Hetherington & Berner, 701 Kentucky Ave., Indianapolis, Ind. Adaptable to any plant.

Chip Spreader

13. Full information concerning their new chip spreader for trucks will be sent promptly by Good Roads Machinery Co., Kennett Square, Pa.

Concrete

15. "Watertight Concrete" is a new booklet presenting sound concrete practice in simple, non-technical language. Contains photographs and diagrams that are easy to understand. Just issued by International Cement Corp., Room 2200, 342 Madison Ave., New York, N. Y.

16. "Winter Construction" isn't a lot of sales promotion copy but is a new booklet full of helpful down-to-earth suggestions on how to save costs in cold weather construction. Write for free copy now. International Cement Corp., 342 Madison Ave., New York, N. Y.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subjects suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Solvay Sales Corp., 61 Broadway, N. Y. C.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Bridges, Culverts and Concrete Products." It includes reports from the Highway Research Board, the Bureau of Public Roads and State Highway Departments. Columbia Products Co., Barberton, Ohio.

36. "Wyandotte Calcium Chloride and its use in Portland Cement Concrete," a booklet covering the subject of curing concrete pavements, structures, etc., giving complete specifications for surface and integral curing. Published by the Michigan Alkali Co., 60 East 42 St., New York, N. Y.

Concrete Mixer

44. Concrete Mixers, both Tilting and Non-Tilting types, from 3 1/2 to 84s size. The Jaeger Machine Company, Columbus, Ohio.

Concrete, Vibrated

50. Data on methods and equipment for, and the results obtained from the use of, vibrating equipment on thin walls, pavements, culverts, bridges, floors and other

concrete construction. Munsell Concrete Vibrators, Teaneck, N. J.

Crushers

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Gallon Iron Works & Mfg. Co., E. Jeffry Mfg. Co., Columbus, Ohio.

Culverts

60. "In diameters up to 10 feet and larger . . ." just issued by the Armco Culvert Mfrs. Assn., tells a good deal about drainage problems and their solution. 32 pages about drainage and multi-plate culverts.

Explosives

74. "Use of Explosives for Settling Highway Fills." A new booklet which fully explains by diagrams and charts the three methods developed after many tests by the Du Pont engineers, which singly or in combination will quickly and efficiently do your job. Just issued by E. I. Du Pont de Nemours & Co., Inc., Explosives Dept., Wilmington, Del.

Floor Construction

75. "Heavy-Duty Floor Construction" is a new data book presenting all essential points in non-technical language. Illustrated with pictures specially taken for this purpose. Sent free to those interested by International Cement Corp., Room 2200, 342 Madison Ave., New York, N. Y.

Graders

76. Latest information about Gallon Motor Patrol Graders, Road Maintainers and Leaning Wheel Graders with hydraulic control is contained in a new series of illustrated catalogs, Nos. 125, 130, 135 just issued by the Gallon Iron Works & Mfg. Co., care of The Jeffery Mfg. Co., Columbus, Ohio.

Loaders and Unloaders

97. Portable Loaders and Unloaders.

Folders: Nos. 1248, 1298 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket elevators for different classes of work; and No. 1256, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, Philadelphia.

100. Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery. Link-Belt Co., Chicago, Ill. General Catalog No. 500.

Motor Trucks

105. Full information about their complete line of motor trucks, all powered by six-cylinder "truck-built" engines of uniform valve-in-head design, will be sent promptly. General Motors Truck Co., Pontiac, Mich.

106. "Trucks for Public Utilities," is a new illustrated booklet just issued by the International Harvester Co., 606 So. Michigan Ave., Chicago. Covers uses, types, special equipment, bodies and specifications. Sent free on request.

Paving Materials

108. "Emulsified Asphalts" is a 56-page manual covering Penetration Type Construction, Road and Plant Mixes Pavements, Surface Treatments and Maintenance Methods. Includes 58 illustrations. Sent free by Headley Asphalt Division, Sinclair Refining Co., P. O. Box 73, Marcus Hook, Penna.

226. "Asphalt Surfacing Materials for Low-Cost Roads" is a handy 28-page booklet illustrating the many types of road surfaces which can be constructed with Texaco asphalt materials. Well illustrated and contains tables of amounts of stone, sand and asphalt required. Sent promptly by the Texaco Company, 135 East 42nd St., New York, N. Y.

109. A 36-page booklet with 66 illustrations has just been issued by the Barrett Co., giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. 24 pages. The Barrett Company, 40 Rector Street, New York.

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(Continued from previous page)

112. Complete directions for surface Cut Back Asphalt are contained in a 36 treatment and bituminous surfacing with page data book. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Protective Coating

118. KRODEPROOF, the ideal protective coating for all structural surfaces subject to corrosion or contact with water is described in an 8-page bulletin recently issued by Lewis Asphalt Engineering Co., 30 Church St., New York, N. Y.

Road Machinery

126. A new general reference catalog No. 1320 covering their entire line of equipment for every approved method of construction and maintenance has just been issued by Austin-Western Road Machinery Co., No. A-5, Aurora, Ill. Profusely illustrated with action pictures showing each type of machine out on the job.

127. "Road Machinery Illustrated." New illustrated bulletins on the motor rollers, three-wheel and tandem rollers, motor graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and straight and leaning wheel graders. Gallon Iron Works & Mfg. Co., Gallon, O.

Rollers

132. A 32-page book in four colors featuring a complete line of road rollers. 8 3/4 x 11, leatherette cover, numerous action pictures. Buffalo-Springfield Roller Co. of Springfield, Ohio.

133. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers and their uses.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., Chicago, Ill.

Shovels, Cranes and Excavators

145. The Austin Badger, a new, fully convertible 3/4 yard crawler shovel, made by The Austin-Western Road Machinery Co., No. A5, Aurora, Ill., is fully described and illustrated in their Bulletin No. 1236.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines, 910 S. Mich. Ave.

Soil Stabilization

150. Explicit instructions for testing soils and constructing and maintaining low-cost stabilized roads are contained in two excellent new booklets. No. 1 contains brief specifications for construction. No. 3 makes clear the procedure in sampling and calculating mixtures. Both are well illustrated with tables of useful information, charts and photographs. Just published by Solvay Sales Corp., 61 Broadway, New York, N. Y.

Street and Paving Construction

Asphalt Mixing Plants

204. A new illustrated bulletin No. M234 describing their asphalt mixers for bituminous paving mixtures of all kinds has just been issued by Hetherington & Berner, Inc., 701 Kentucky Ave., Indianapolis, Ind. Covers both steam-jacketed, steam operated; and hand operated types. Sent on request.

Distributors

206. Kinney distributors of from 600 to 1,700 gallon tank capacity with heating system and the Kinney jacketed pump having a capacity of over 400 gallons per minute are described in a new catalog just published by the Kinney Mfg. Co., 3533 Washington St., Boston, Mass.

Dust Control

209. "3000 men put back to work in a single county." A new folder just issued by the Solvay Sales Corp., 61 Broadway, New York City, outlining a road program which is a relief program. Sent promptly on request.

210. "How to Maintain Roads with Dowflake" is a new 58 page illustrated booklet of information on stabilized road construction. Includes specifications and several pages of reference tables from an engineer's notebook. Just issued by Dow Chemical Co., Midland, Mich.

211. "Principles of Road Soil Stabilization," a new booklet just issued by The Columbia Alkali Corporation, Barberton, Ohio. Gives a clear, concise picture of what road soil stabilization is and how it can be accomplished.

212. "Wyandotte Calcium Chloride Prevents Dust the Natural Way"—a publication, fully illustrated, treating on Dust Control, economical road maintenance and methods of application, issued by the Michigan Alkali Company, 60 E. 40th St., New York City.

Dust Laying

213. Full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5 1/2 x 8, covers application, economies, etc. Sent without cost. Solvay Sales Corporation, New York.

Guard Rail

26. Accurate cost comparisons in erection of thousands of feet of Tuthill guard rail compared with other types. Everyone contemplating the construction of guard rail should have this data. Tuthill Spring Co., 760 Polk St., Chicago, Ill.

Mixed-in-Place

218. "Mixed-in-Place" bituminous road construction. The construction of low-cost, dustless, mudless roads in a new and better way with the Parsons "Turbo-Mixer." Full details sent promptly by The Parsons Company, Newton, Iowa.

Surface Heaters

220. The "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is described and its use illustrated in Bulletin 6. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Noiseless Manhole Covers

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

Brick-Paving

230. Full information and data regarding the use of vitrified brick as a paving material, cost, method of laying, life, etc. National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. 47 pages. The Dow Chemical Company, Midland, Mich.

Gutters

240. "Brick Gutters and Parking Strips." A study dealing with the problems faced in the proper construction of gutters and how they can be overcome. Covers design, construction and results. Well illustrated. Just issued by the National Paving Brick Ass'n, National Press Building, Washington, D. C.

Jacking Culverts

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passage-ways under streets, highways and railroads. "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

Sanitary Engineering

Clarifying Tanks

383. Loughlin Clarifying Tanks for the more complete removal of suspended solids from sewage and industrial wastes at lower cost are described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

Cleaning Water Mains

384. How to clean water mains by The National Method, using your local unemployed labor. Full information will be sent at once by The National Water Main Cleaning Co., 50 Church St., New York, N. Y.

Sludge Drying

385. Relatively dry cake sludge in demand for fertilizer is produced by automatic continuous vacuum filters like those used in Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C. Write for literature. Oliver United Filters Inc., 33 West 42nd St., New York, N. Y.

Activation and Aeration

390. A booklet of value to sanitary and chemical engineers describes Norton Porous Mediums of bonded fused alumina (strong chemically stable, uniformly permeable) and their use in aeration of water and sewage. Norton Co., Worcester, Mass.

Glass Covers

393. Full details regarding the use of Lord & Burnham Glass-Covers at Middletown, N. Y.; Marion, Ohio; Cleveland, Ohio; Freeport, N. Y.; Kitchener, Canada; West Chester, Pa., and other places are given in bulletins 22 to 33. Sent promptly on request to Lord & Burnham Co., Irvington, N. Y.

Jointing Materials

396. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Leak Locating Instrument

399. Transmit-O-Phone, an inexpensive, super-sensitive little instrument for locating leaks and defects in pipes, hydrants and meters, is described in an illustrated circular which will be sent promptly by International Metal & Specialty Co., Box 152, Berlin, N. J.

Locator

401. Locating hidden valve and stop boxes is easy if you have a magnetic dip compass. Complete details on use sent promptly by W. F. Sprengnether, 14 No. 9 St., St. Louis, Mo.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

Pipe, Cast Iron

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

407. New 1934 Handbook of Super-detables and data for the water works man on pipe line construction, weights, and dimensions. 40 pages, handy pocket size. United States Pipe & Foundry Co., Burlington, N. J.

Pipe Forms

409. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Taste and Odor Control

411. How, when and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Co., Inc., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Screens, Sewage

417. The simple, automatic Loughlin self-cleaning traveling screen is fully described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link-Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

420. A useful new bulletin for all those interested in sewage disposal, describing some of their proven equipment such as self-cleaning bar screens, grit conveyors, sludge collectors and shredders, has just been issued by the Jeffrey Mfg. Co., Columbus, Ohio. Includes diagrams and many illustrations.

Screens

424. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

426. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. 1. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Incineration

427. "Incineration Ends the Sewage Disposal Problem" is a new booklet describing the C-E Raymond guaranteed odorless and efficient method of sewage sludge drying and incineration. Just issued by Combustion Engineering Co., 200 Madison Ave., New York, N. Y.

428. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications, Morse-Boulger Destructor Co., 202 East 44th St., N. Y.

Treatment

429. A new series of bulletins describing their full line of sewage treatment equipment—Fine Screens, Schofield Bar Screens, Vacuum Filters for Sewage Sludge, Decarie Screenings Incinerators, Schofield Bar and Fine Screens, Vacuum Filters for Sewage Filtration and Pneumatic Ejectors for Sewage Screenings—are ready for distribution on request to Municipal Sanitary Service Corp., Room 2703, 155 East 44th St., New York, N. Y.

430. Separate bulletins showing their many lines of sewage treatment equipment will be sent promptly by The Pacific Flush Tank Co., Chicago and New York. The latest is No. 110 describing tray clarifiers.

431. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters, Inc., 33 West 42nd St., New York, N. Y.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., and Philadelphia.

200. For general construction and maintenance, the Original Improved "Hot-stuf" Asphalt Heater, an economical oil burning heater. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Road and Street Maintenance

Bituminous Materials

225. A comprehensive manual on the "Use of Emulsions for Street and Highway Construction and Maintenance," discussing types, uses, relative costs, construction details, etc., will be sent promptly on request by Headley Asphalt Division, Sinclair Refining Co., P. O. Box 73, Marcus Hook, Penna.

226. "Asphalt Surfacing Materials for Low-Cost Roads" is a handy, 28-page booklet illustrating the many types of road surfaces which may be constructed with Texaco asphalt materials. Well illustrated and contains tables of amounts of stone, sand and asphalt required. Sent promptly by the Texas Company, 135 East 42nd St., New York, N. Y.

227. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

228. A new booklet has just been issued by The Barrett Co., 40 Rector St., New York, describing and illustrating the uses of each grade of Tarvia and Tarvialithic. 32 excellent illustrations.

229. A new series of concise and authoritative manuals of con-

struction covering the latest developments in road-mix and surface treatment types as well as the standard asphalt pavements. These contain the best that has been developed by study, research and practical application in all types. Manual 1—Road-Mix Types is now ready for distribution. The Asphalt Institute, 801 Second Ave., New York, N. Y.

229A. Surface Treatment Types, Asphalt Road Construction Manual No. 2. Full details on surface treatments. 14 chapters, 128 pages. The second of those tremendously valuable and handy little manuals put out by the Asphalt Institute, 801 Second Avenue, N. Y. Sent on request.

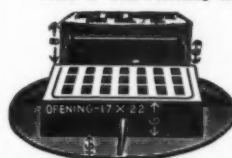
Snow Removal

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

359. Gallon Iron Works and Mfg. Co., Gallon, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

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Made of wear-resisting chilled iron in various styles, sizes and weights



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For the Engineer's Library

The editors will be glad to assist readers in getting copies of publications mentioned here.

Thawing Mains; "Ways to Do It."

This manual, just published by Hobart Bros., Troy, Ohio, gives costs of thawing pipes, time required, connection methods and results obtained. To readers interested in arc welders, this will be sent free on request; to others, who wish it only for reference, a charge of 40 cents will be made. Suitable for mains up to 6 inches in diameter and up to 2000 feet long, it is said.

Winter Construction:

Winter-placed concrete; simple essentials of successful work; winter work on highways; on bridges, on buildings, and on sewers and pre-cast products, are all covered in an excellent, but brief, 12-page booklet issued by International Cement Corp., 342 Madison Ave., N. Y. Copy on request.

Ozone for Water Treatment:

An 8-page booklet has been issued by the Ozone Corp., 332 South Michigan Ave., Chicago, Ill., which gives some detailed information about the use of ozone for water treatment. Sent on request.

Calcium Chloride and Brick Pavements:

The problem of removing the excess asphalt filler from new brick pavements has received quite a bit of attention lately. Solvay Sales Corp., 61 Broadway, N. Y., has issued a piece of literature covering the use of calcium chloride in this work. Sent free on request.

A Primer on Sheet Iron:

In simple, non-technical language, this booklet of 64 pages tells the step-by-step story of modern manufacture of sheet iron, from the ore mine to the completed sheet. It also contains gauge tables and a glossary of metallurgical terms. Ask for Bulletin 127, Republic Steel Corp., Massillon, Ohio.

Story of the Boulder Dam IV.:

The fourth bulletin describing Boulder Dam is now ready. It contains descriptions of the cofferdams, the aerial cableways, the tunnels, the penstocks and the canyon wall outlets. It also tells of the method of pouring the concrete, and how the concrete is cooled while being poured. 48 pages. Write G. W. Morrison, 11 Broadway, N. Y., for free copies of this publication by Ingersoll-Rand. Better than most things you get for nothing.

What you Want to Know About Guard Rails:

A lot of good information on highway guards, excellent illustrations, engineering information, specifications and methods of installation are available in a 16-page booklet just published by Page Steel & Wire, Monessen, Pa. Free on request.

Truck and Trailer Size and Weight Restrictions:

This 56-page handbook gives all the legal restrictions as to size and weight of trucks and trailers for each state. Revised to October 1, 1934. Free on request to FWD Co., Clintonville, Wisc.

The Rational Design of Asphalt Paving Mixtures:

This 24-page publication contains 4 papers: The Principles of Design; Stability and Related Tests; Application of Results to Asphalt Paving Mixtures; Adaptation of the Stability Test to Include Coarse Aggregate Asphalt Paving Mixtures. This is the second edition of the pamphlet; the first edition did not include the last mentioned paper. Sent on request to Asphalt Institute, 801 Second Ave., N. Y.

For the Welders:

Two new booklets have been issued by the Linde Air Products Co., New York City. They are: "Recommended Practices for Gas Cutting of Structural Steel" and "Precautions and Safe Practices." The first contains 16 pages, the second, 24 pages. Either or both will be sent on request.

Valve Controlling Equipment:

A pamphlet on water controlling equipment, covering circular sluice gates, rectangular sluice gates, floor stands, drain or mud valves, flap valves, and gate valves for low pressures has been issued by the Colombian Iron Works, Chatanooga, Tenn. This is fully illustrated with drawings and gives all necessary dimensions, so that it is of real value for reference and when preparing plans.

Plague—A Health Menace:

This is a brief article, based on a radio talk by W. H. Kellogg, Chief, Bureau of Laboratories, California Department of Public Health. It recounts the history of plague, tells of the deaths it has caused, and tells briefly of the basic methods of control. Dr. W. H. Kellogg, Department of Health, State Office Building, Sacramento, Calif.

Unemployment Relief Census:

This is a book of 143 pages issued by the Federal Emergency Relief Administration, which contains a summary, in printed form, of the families receiving relief in October, 1933. Summarized by size of family, color, age, sex of persons in families, by principal cities and by geographic divisions. No data on cost. Probably can be obtained from Federal Emergency Relief Administration, Washington, D. C., without cost while supply lasts.

How to Hire Welders:

This booklet outlines simple tests for measuring the ability of welders. Also contains other data of interest. 24 pages. Issued by the Linde Air Products Co., 30 East 42nd St., New York. An 8-page pamphlet on bronze welding is also issued by the same company.

English Local Government:

England has a multitude of local government problems which in many ways are closely linked to those of the United States. This study of people much like ourselves should help us get a fairer perspective of American needs and methods. By Herman Finer. 553 pages. \$5.50.

The Euclid Pioneer:

The first issue of this publication, put out by the Euclid Road Machinery Co., Cleveland, Ohio, has been received. H. E. Orr, who is responsible for this, has done a fine job in making an interesting and readable little booklet for the earth mover and material handler. Sent on request to Mr. Orr.

The Groundhog's Golden Anniversary:

We haven't the space here to do justice to the Fiftieth Anniversary issue of "The Groundhog," published by the Marion Steam Shovel Co. It contains the kind of reading every engineer should enjoy. A real history of the developments in shovel design during the past 50 years. Pictures of the early shovels. The best thing we can do is to suggest you write the Marion Steam Shovel Co., Marion, O., and ask them to send you a copy.

Steel Piling Extractor:

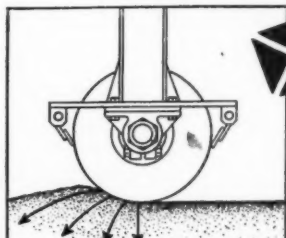
Pile extractors described in this bulletin will handle about all types of steel piling without requiring special rigging. The bulletin describing these McKiernan-Terry pile extractors is illustrated with many pictures of actual jobs, and also contains specifications. Ask for Bulletin 50, McKiernan-Terry Corp., 15 Park Row, N. Y.

Highway Equipment:

Distributors, oil supply tanks and semi-trailers for bituminous highway construction or maintenance are described in Bulletin J-16, just issued by Littleford Bros., Cincinnati, O. The Trail-O-Distributor, which hitches onto the end of a supply tank, is featured.

RESULTS . .

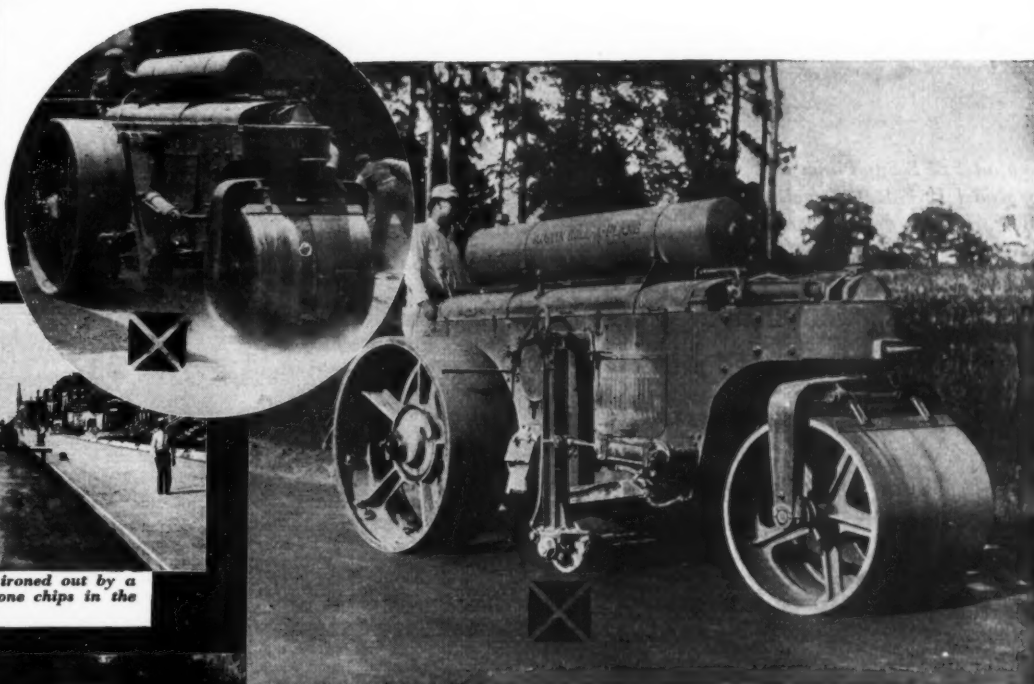
tell the spot-pressure story!



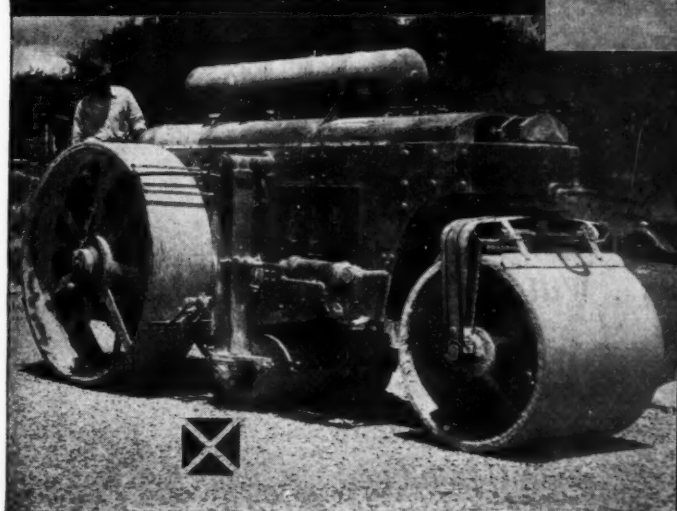
Breakdown rolling of a sheet asphalt pavement. The constant pressure of the Center Roll meets and reduces all irregularities—not only smoothly but true to plane.



Old asphaltic concrete pavement ironed out by a Roll-A-Plane. White areas are stone chips in the surface cleaned by the pressure.

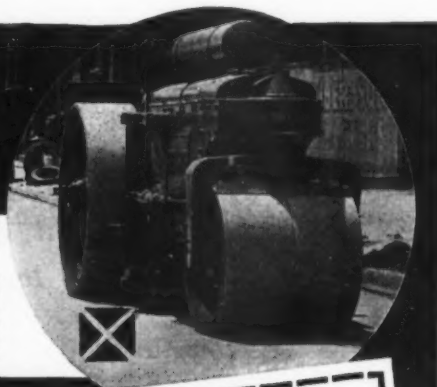


Entirely new performance from a road roller is demonstrated here in the finish rolling of a road-mix—a true plane surface without cross rolling, the remarkable result of the Center Roll principle.



The Center Roll is shown here on a bituminous macadam job which showed under final test a surface smoothness equal to the usual specifications for pavement of the highest type.

Finish rolling of sheet asphalt pavement. Write for new 8-page bulletin describing the Roll-A-Plane principle and its remarkable record of actual performance and savings.



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Tools . . . Quickly Attached and Detached*

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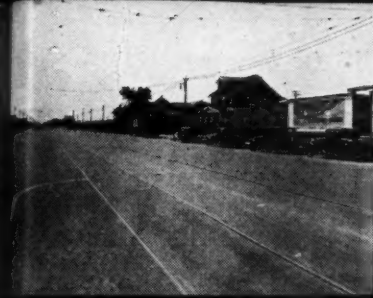
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West side of
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in the heart of
"downtown"
Detroit

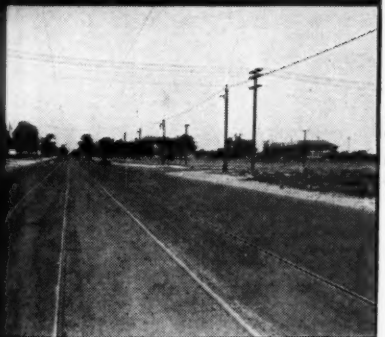


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between Linwood
and Livernois.

Stanolind Asphalts in DETROIT



Livernois between
Fenkell Avenue
and McNickols
Highway.



Lafayette Avenue
between 12th and
Third Streets.



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and Chalfont
Streets on Liver-
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● Detroit, Michigan, ranks high in the percentage of streets which are paved with Asphalt.

The asphalt construction engineers have used many different kinds of asphalt during the last thirty years and the types of pavement and the methods of construction have kept pace with all the best practices in which this City has led in most respects. This is a very creditable achievement, due to the fast growth during the last twenty years, which developed a necessity for durable types of paving on many streets.

Stanolind Paving Asphalt, which is a product of the Standard Oil Company (Indiana), has been used by the City of Detroit with excellent results.

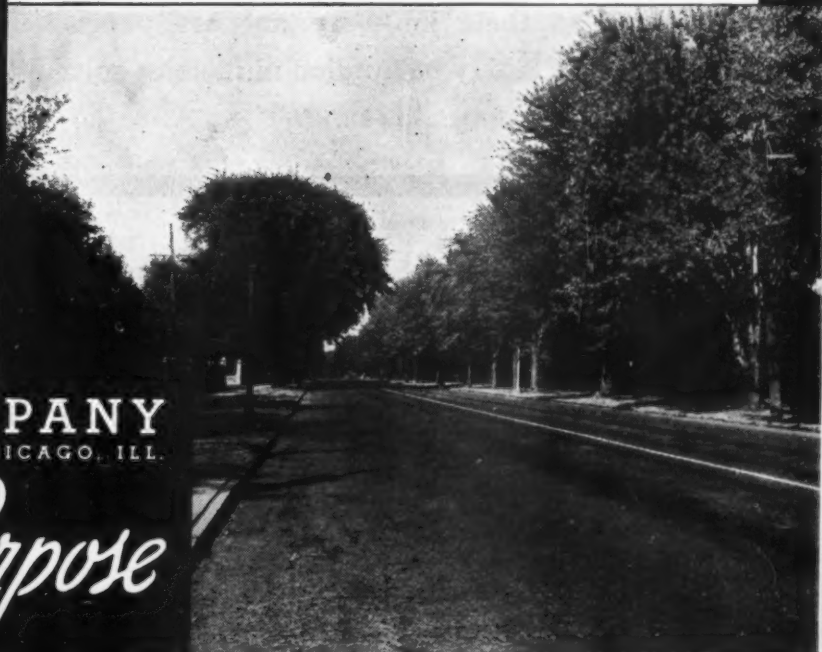
The copies of photographs shown are illustrations of the results secured.

Copy. 1934, Standard Oil Co.



STANDARD OIL COMPANY
910 S. MICHIGAN AVE. (Indiana) CHICAGO, ILL.

Asphalt for every Purpose

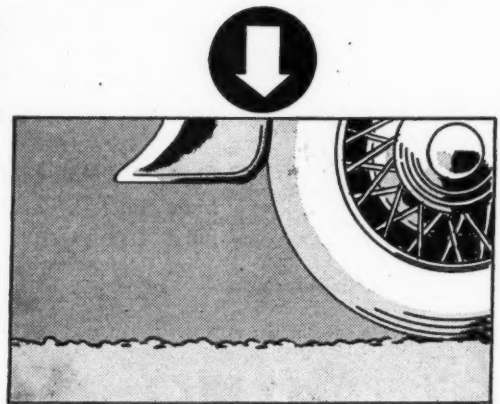


PAVING ★ ASPHALT ★ FOR ★ DAVING ★

"Protecting lives and property from the menace of ice on traffic inclines, curves and intersections is a responsibility of municipal officials as grave as that which is theirs toward the public's safety against crime, fire and disease."

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Grit materials spread over icy pavements prevent skidding far more effectively when treated with Calcium Chloride. Its thawing action lets the grit particles "dig in" instead of sliding along with tires or shoes.



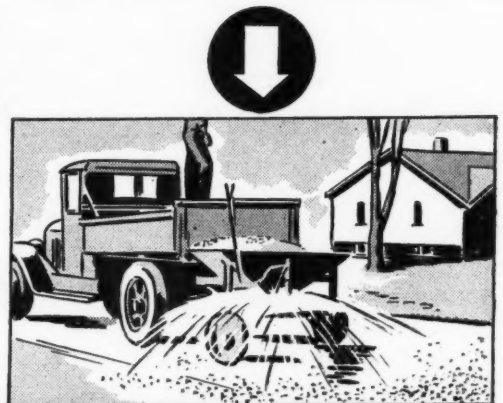
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Stock piles of sand or cinders treated with Calcium Chloride (as little as 50 pounds per cu. yd.) will not freeze. They remain loose, loadable, spreadable in severest cold . . . instantly ready for emergency use.



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For literature giving complete details about Calcium Chloride for ice control, write to any of these members of the CALCIUM CHLORIDE ASSOCIATION:

THE DOW CHEMICAL COMPANY . . . Midland, Michigan
THE COLUMBIA ALKALI CORPORATION . Barberton, Ohio
MICHIGAN ALKALI COMPANY, 60 E. 42nd St., New York City
SOLVAY SALES CORPORATION, 61 Broadway, New York City

CALCIUM CHLORIDE

FOR BETTER ICE CONTROL

When you need catalogs—consult the *classified* READERS' SERVICE DEPT., pages 75-77.



Do Your Specifications Include

Norton Porous Plates or Tubes?

IN CITIES throughout this country and across the Atlantic and the Pacific, Norton Porous Mediums—Tubes and Plates—are establishing enviable performance records.

Back of them is over thirty years' experience in the production of ceramically bonded products of electrically fused alumina. Back of them is many years of experience in the application of porous mediums to various kinds of activated sludge sewage disposal plants.

If you are interested in the design or construction of a sewage disposal plant of the activated sludge type it will pay you to make sure that the specifications include Norton Porous Plates or Tubes. Complete information about them on request.

TOP ILLUSTRATION: Norton Porous Plates at Decatur, Illinois; BOTTOM: Norton Porous Tubes at Woonsocket, Rhode Island.

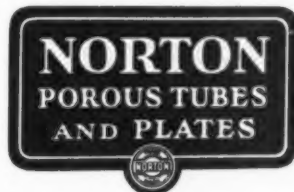
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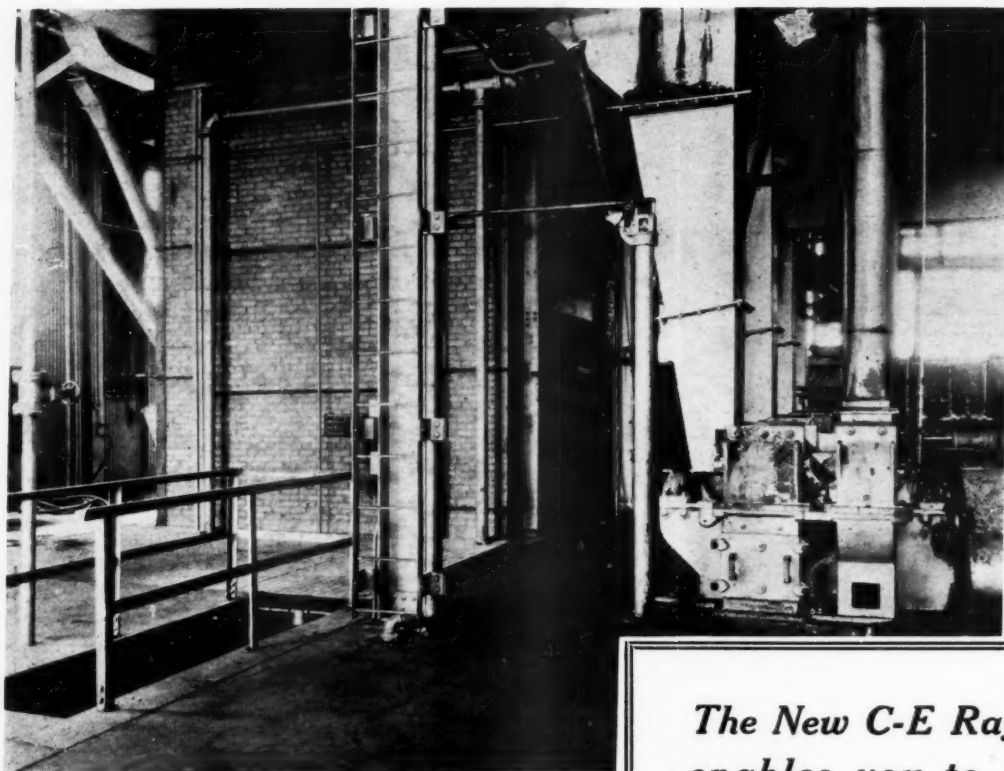
CLEVELAND



R-472

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View of furnace and sludge drying equipment in the West Side Sewage Treatment Works of the Sanitary District of Chicago.

*The New C-E Raymond System
enables you to dewater, dry
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Cost and without Odor.*

In recent years energetic attacks have been made on the problem of sewage disposal. All that have made substantial progress point to sewage sludge incineration as the logical method of disposing of the end product of sewage treatment.

The difficulty has been to develop a system of incineration that would assure complete combustion at a sufficiently low cost to be practicable, and with absolute assurance of odorless operation.

The C-E Raymond System, now successfully applied in a commercial unit at the West Side Sewage Treatment Works of the Sanitary District of Chicago, has completely demonstrated its ability to

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We are prepared to furnish C-E Raymond System Units for conditioning and burning any type of sewage sludge; and to fully guarantee capacity, thermal efficiency and odorless operation. Write for BULLETIN—"Incineration Ends the Sewage Problem."

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A-183

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